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Revision 0

# Description of Work for Vadose Zone Characterization of the 1301-N and 1325-N Liquid Waste Disposal Facilities

United States
Department of Energy
Richland, Washington

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# Description of Work for Vadose Zone Characterization of the 1301-N and 1325-N Liquid Waste Disposal Facilities

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Richland, Washington 99352

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**APPENDICES**:

## CONTENTS (Continued)

**FIGURES:**



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# ACRONYMS

| | |
|---|---|
| ALARA | as low as reasonably achievable |
| BHI | Bechtel Hanford, Inc. |
| bgs | below ground surface |
| CERCLA | *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* |
| DOW | description of work |
| DQO | data quality objectives |
| Ecology | Washington State Department of Ecology |
| EII | Environmental Investigations Instructions |
| EIP | Environmental Investigation Procedures |
| EPA | U.S. Environmental Protection Agency |
| FTL | field team leader |
| HASM | Hanford Analytical Services Management |
| HEIS | Hanford Environmental Information System |
| LFI | limited field investigation |
| LWDF | Liquid Waste Disposal Facility |
| QA | quality assurance |
| QAPjP | Quality Assurance Project Plan |
| QC | quality control |
| RCRA | *Resource Conservation and Recovery Act of 1976* |
| RCT | radiological control technician |
| RFI/CMS | RCRA Facility Investigation/Corrective Measures Study |
| RL | U.S. Department of Energy, Richland Operations Office |
| SAFER | Streamlined Approach for Environmental Restoration |
| SAP | Sampling and Analysis Plan |
| Tri-Party Agreement | *Hanford Federal Facility Agreement and Consent Order* |
| TSD | treatment, storage, and/or disposal |
| WAC | Washington Administrative Code |
| WHC | Westinghouse Hanford Company |

# 1.0 SCOPE OF WORK

This description of work (DOW) details the field activities associated with a limited field investigation (LFI) of soil contamination beneath the 1301-N and 1325-N Liquid Waste Disposal Facilities (LWDFs), and will serve as a field guide for those performing the work. These activities are undertaken pursuant to the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1994a) Milestone M-16-94-01H-T1 and the June 30, 1994, Milestone Change Request M-16-94-02 (Ecology et al. 1994b). The scope of these activities was defined during a Streamlined Approach for Environmental Restoration (SAFER) workshop and a U.S. Department of Energy, Richland Operations Office (RL) workshop where data quality objectives (DQOs) and technical criteria for the LFI were developed. Results of the SAFER workshop and the RL workshop are discussed in Section 1.1.

Other supporting documents to be used in conjunction with the DOW include the *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-NR-1 Operable Unit, Hanford Site, Richland, Washington* (DOE-RL 1994) for operable unit-scale investigation strategy and the *Environmental Investigations Procedures* (BHI 1995c) for specific procedures. The 1301-N and 1325-N LWDFs are identified as the 116-N-1 and 116-N-3 sites in the 100-NR-1 Operable Unit *Resource Conservation and Recovery Act of 1976* (RCRA) Facility Investigation/Corrective Measures Study (RFI/CMS) Work Plan (DOE-RL 1994). The locations of the 1301-N and 1325-N LWDFs (116-N-1 and 116-N-3) are shown in Figure 1. Both the 1301-N and 1325-N LWDFs consist of a crib and a trench. Both LWDFs were used to receive and dispose of the cooling water originating from the 100-N Reactor and are classified as RCRA treatment, storage, and/or disposal (TSD) units. The LWDFs are no longer receiving waste effluent. Although these facilities are classified as RCRA TSD units, the RL and regulatory agencies have determined that this LFI will be conducted as a past-practice investigation under the auspices of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), in accordance with the *Hanford Site Past-Practice Investigation Strategy* (DOE-RL 1991) and the 100-NR-1 Operable Unit RFI/CMS Work Plan (DOE-RL 1994).

## 1.1 SUMMARY OF THE DATA QUALITY OBJECTIVES PROCESS

The DQO process is used to assess how much characterization data are required, the uses of the data, and how decisions will be made. In this case, data collection is in support of an LFI to be conducted at the 1301-N and 1325-N LWDFs in the 100-NR-1 Operable Unit. Previous work in the SAFER process resulted in a costly and exposure-intensive DOW. The RL requested that the Environmental Restoration Contractor (ERC) use the DQO process to further evaluate the decisions and data needs associated with the 1301-N and 1325-N LWDFs LFI. Details of the DQO process are reported in *Data Quality Objectives Workshop Results for 1301-N and 1325-N Characterization* (BHI 1995b).

Existing sediment data from within the 1301-N trench and 1325-N crib were collected and assessed. Soil borehole data in the general vicinity of the LWDFs were consolidated and evaluated. A conceptual model was established that divided the subsurface region into six zones for each key contaminant. These conceptual models are detailed in Appendix A. It was determined that no data existed for two zones directly beneath the facilities. Soil data did exist outside of each LWDF "footprint" and for the surface layer in the 1301-N trench and 1325-N crib.

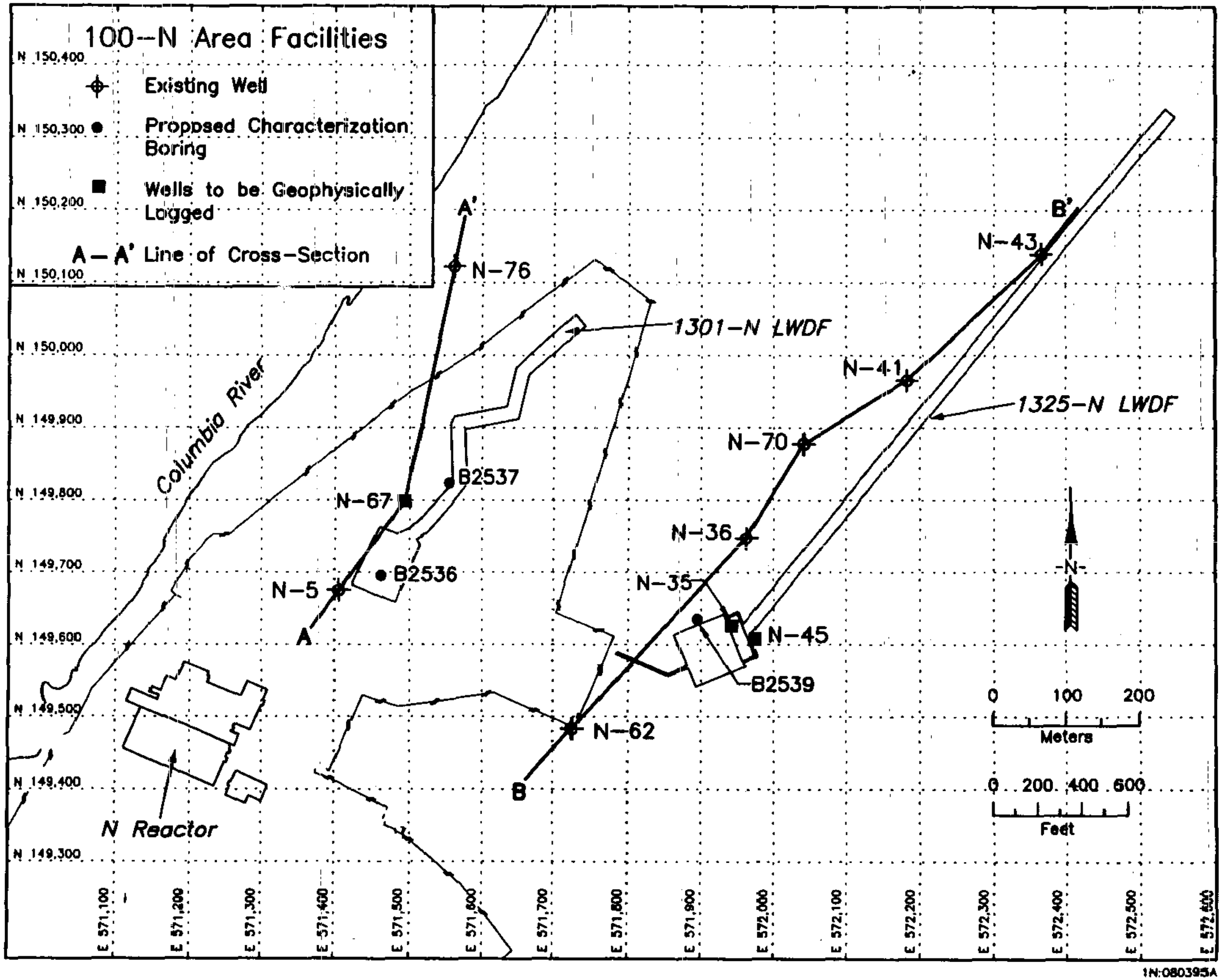


Figure 1. Locations of 1301-N and 1325-N Liquid Waste Disposal Facilities, Proposed Characterization Boreholes, and Existing Wells to be Geophysically Logged.

The DQO team compared the original DOW to three alternatives, using the following DQO objectives and criteria:

- Provide sufficient information to evaluate remedial alternatives
- Provide sufficient information to prepare a qualitative risk assessment
- Provide sufficient information to assess impact to groundwater and existence of a driving force
- Provide sufficient information to estimate total inventory and confirm conceptual model
- Provide sufficient information to assess lateral distribution
- Provide sufficient information to evaluate dangerous waste
- Provide sufficient information to evaluate transuranic waste
- Keep exposures as low as reasonably achievable (ALARA)
- Be cost-effective.

The process used to develop and rank the three DOW alternatives is documented in BHI (1995b). Although all three DOW alternatives meet the DQOs, Alternatives 2 and 3 are considered to provide the best characterization approach.

Alternatives 2 and 3 require one borehole in the 1301-N crib that will confirm or deny the conceptual model of vertical contaminant distribution in the vadose zone beneath the facility. Both alternatives require one borehole near the highest surface concentration area, but not directly in the 1301-N trench, to provide data regarding lateral movement of contaminants and physical properties of the vadose zone soils at a low cost and exposure. Both alternatives require neutron moisture and spectral gamma-ray logging of three existing boreholes near the 1301-N and 1325-N LWDFs. Both alternatives use the same analytical strategy. Cost savings for Alternative 2, when compared to the existing DOW, is approximately $2.7 million.

Alternative 3 requires an additional borehole next to the 1325-N crib, which is not required by Alternative 2. Cost savings for Alternative 3, when compared to the existing DOW, is approximately $1.7 million.

Implementation of Alternative 2 would require the assumption that the 1325-N LWDF is analogous to the 1301-N LWDF. Soil sampling and geophysical logging in the two proposed characterization boreholes at the 1301-N LWDF in combination with geophysical logging at three existing wells near the 1301-N and 1325-N LWDFs would be used to validate the analogous site approach.

Implementation of Alternative 3 does not require the analogous site approach at the 1325-N LWDF. Data and information collected from the additional characterization borehole and geophysical logging of existing monitoring wells would be used to directly assess the distribution of contaminants and moisture in the vadose zone near this facility.

The RL and ERC believe that Alternative 2 provides sufficient information to address the DQOs established for the 1301-N and 1325-N LWDFs LFI. However, the Washington State Department of Ecology (Ecology) and the U.S. Environmental Protection Agency (EPA) prefer Alternative 3 due to their concerns over the applicability of the analogous site approach at the 1325-N LWDF. The RL and regulatory agencies have subsequently agreed to implement Alternative 3 to address these concerns.

## 1.2 APPROACH

The field activities described in this DOW will provide data for the evaluation of remedial alternatives, and to confirm that the 1301-N and 1325-N LWDFs are high-priority sites. In addition, the data will be used to verify and refine the facility conceptual models and evaluate the potential for an impact to groundwater resulting from drainage of residual crib/trench effluent and leaching of contaminants beneath the facilities. Contaminants of potential concern are listed in Table 1.

Table 1. Contaminants of Potential Concern and Analytical Techniques.

| Contaminants of Potential Concern | General Analytical Technique |
|---|---|
| Potassium-40 | Gamma spectrometry |
| Manganese-54 | |
| Cobalt-60 | |
| Strontium-90 | Beta counting |
| Ruthenium-106 | Gamma spectrometry |
| Cesium-134 | |
| Cesium-137 | |
| Cerium-144 | |
| Europium-154 | |
| Europium-155 | |
| Radium-226 | |
| Thorium-228 | |
| Thorium-232 | |
| Uranium-233/234 | Alpha spectrometry |
| Uranium-238 | |
| Plutonium-238 | |
| Plutonium-239/240 | |
| Cadmium | Inductively coupled plasma analysis |
| Chromium | |
| Nickel | |
| Lead | |

Three vadose zone boreholes, B2536, B2537, and B2539, will be drilled and sampled to investigate the distribution of radionuclides, metal contaminants, and moisture in the soil column beneath the LWDFs. Borehole B2536 will be drilled within the 1301-N crib, while boreholes B2537 and B2539 will be drilled adjacent to the 1301-N trench and 1325-N crib, respectively. This approach is identified as Alternative 3 in the DQO workshop document (BHI 1995b). The general locations of the boreholes are shown in Figure 1; detailed locations and maps are provided in Appendix B.

Borehole B2536 will provide data on the vertical distribution of contaminants and moisture with depth in the highest contaminant zone (1301-N crib). Borehole B2537 will provide information on the lateral spreading of contaminants near the 1301-N trench, moisture distribution with depth, and physical properties of geologic strata in the vicinity of the 1301-N LWDF. Data and information collected from borehole B2539 will be used to assess the distribution of contaminants and moisture with depth and physical properties of geologic strata in the vicinity of the 1325-N LWDF. Spectral gamma-ray and neutron moisture geophysical logs will be collected at all three characterization boreholes and at existing monitoring wells near the 1301-N and 1325-N LWDFs. These logs will provide information regarding the vertical and lateral distribution of gamma-emitting radionuclides and moisture beneath and near the 1301-N and 1325-N LWDFs. The existing monitoring wells to be logged include 199-N-35, 199-N-45, and 199-N-67. The locations of these wells are illustrated in Figure 1.

## 1.3 SITE BACKGROUND AND GENERAL SUBSURFACE CONDITIONS

### 1.3.1 1301-N Liquid Waste Disposal Facility (116-N-1)

The 1301-N LWDF consists of a crib and a trench. This facility is located about 300 m (1,000 ft) east of the N Reactor building (see Figure 1). The 1301-N LWDF operated from 1964 until September 1985 as the primary liquid waste disposal system for N Reactor. The 1301-N crib is an 88-m- (290-ft) long by 38-m- (125-ft) wide rectangular basin with a 16-m- (52-ft) by 3.7-m- (12-ft) concrete weir box. The 1301-N crib was constructed by excavating the existing soil, surrounding the excavation with a soil and gravel embankment, and then placing a 1-m (3-ft) layer of large stones on the excavation floor. The walls of the 1301-N crib are a sloped soil and gravel embankment, and the depth is about 3.7 m (12 ft) from the floor to ground surface. A zigzag extension trench 3 m (10 ft) wide across the bottom and 3.7 m (12 ft) deep extends 490 m (1,600 ft) from the crib. The 1301-N trench was built in 1965. Precast concrete cover panels 15 m (50 ft) wide were placed over the 1301-N trench in 1982. The panels are grouted together and shotcrete was placed on the 1301-N trench embankments. The cover panels are intended to minimize wildlife intrusion and airborne contamination.

### 1.3.2 1325-N Liquid Waste Disposal Facility (116-N-3)

The 1325-N LWDF consists of a crib and trench. This facility is located about 300 m (1,000 ft) east of the 1301-N LWDF (see Figure 1). The 1325-N LWDF was used from 1983 until August 1993. The 1325-N LWDF became the primary liquid waste disposal system for N Reactor in 1985. The 1325-N crib is a 76-m- (250-ft) long by 73-m- (240-ft) wide rectangular basin that is covered with precast, prestressed concrete panels that are sealed with grout. The concrete cover is about 3 m (10 ft) lower than the surrounding grade. The percolation surface is less than 1.5 m (5 ft) below the cover. Rock was placed on the slopes adjacent to the 1325-N crib to minimize wind erosion. A straight extension trench 16.8 m (55 ft) wide and 2.1 m (7 ft) deep extends 914 m (3,000 ft) from the 1325-N crib, although only the first 228 m (750 ft) of the 1325-N trench received effluent. The extension trench is covered with precast concrete panels. The 1325-N trench cover panels are not grouted or shotcreted and have lifting lugs to facilitate removal. The 1325-N trench cover is intended to minimize wildlife intrusion and airborne contamination.

### 1.3.3 Geology

The vadose zone in the vicinity of the 1301-N and 1325-N LWDFs is dominated by the glaciofluvial gravels and sands of the Hanford formation and the underlying fluvially deposited Unit E sands and gravels of the Ringold Formation. Detailed stratigraphic and textural characteristics of these geologic units in the 100-N Area can be found in Hartman and Lindsey (1993). Groundwater is encountered at approximately 20 to 23 m (65 to 75 ft) below ground surface (bgs) in the vicinity of the 1301-N and 1325-N LWDFs. General stratigraphic relationships of these two geologic units are illustrated by the geologic cross sections A-A' and B-B' (Figures 2 and 3). The trend and location of sections A-A' and B-B' are shown in Figure 1.

The upper portion of the Hanford formation is composed of unconsolidated cobble and boulder-sized clasts. Boulders as large as .9 m (3 ft) in diameter have been encountered in the upper portion of the Hanford formation. Thickness of this extremely coarse-grained unit is typically 3 to 6 m (10 to 20 ft). Below the cobble-boulder unit, clast size decreases to pebbles and cobbles with sand locally dominating the stratigraphy. Additionally, thin and discontinuous sand and silt zones are known to be present within this portion of the Hanford formation in the vicinity of the 1301-N and 1325-N LWDFs. Although the Hanford formation is clast supported, the intergranular space has been observed to be filled with sand and silt in local gravel pits. Open framework textures (i.e., no finer grained matrix) have been commonly observed throughout the 100 Areas and thus may also exist in the 100-N Area (Hartman and Lindsey 1993).

The underlying Ringold Formation is composed of pebble to cobble-sized gravels with a sandy matrix. These gravels may be clast or matrix supported. Ringold fluvial gravels may be well cemented with carbonates and/or iron oxides. Cementation is discontinuous but laterally extensive.

## 2.0 GENERAL REQUIREMENTS

### 2.1 SAFETY AND HEALTH

Field activities described in this DOW will be performed in various radiological environments including surface contaminated areas, high radiation areas, and very high radiation areas. All ERC personnel performing field work will have completed the 40-Hour Hazardous Waste Site Worker Training Program and Radiation Worker II training as required in the site Health and Safety Plan. All work will be performed in accordance with the following:

- HSRCM-1, *Hanford Site Radiological Control Manual*, Rev. 2 (HSRCM 1994)
- *ALARA Program* (BHI 1995a)

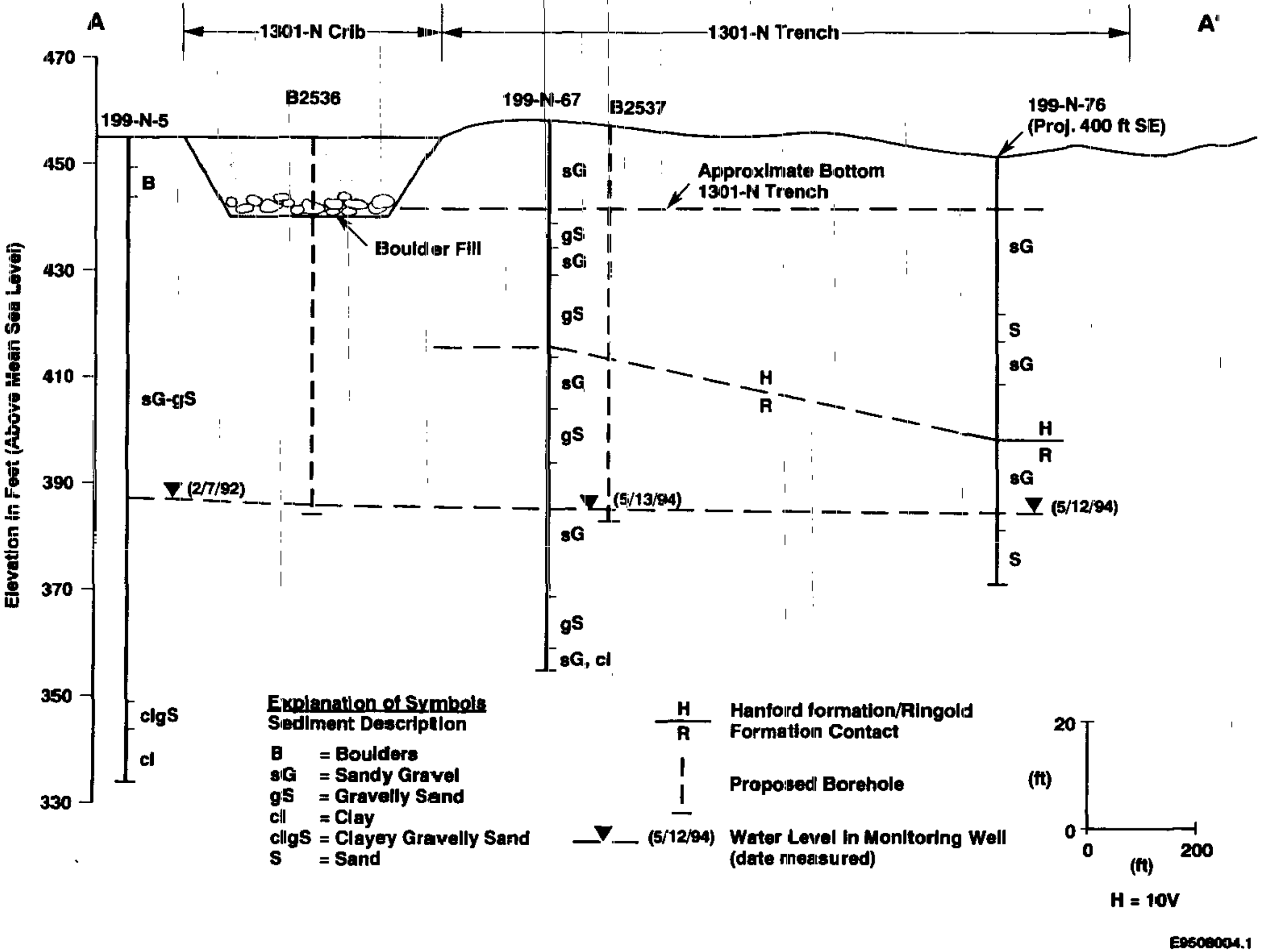


Figure 2. Geologic Cross Section A-A' for 1301-N Liquid Waste Disposal Facility.

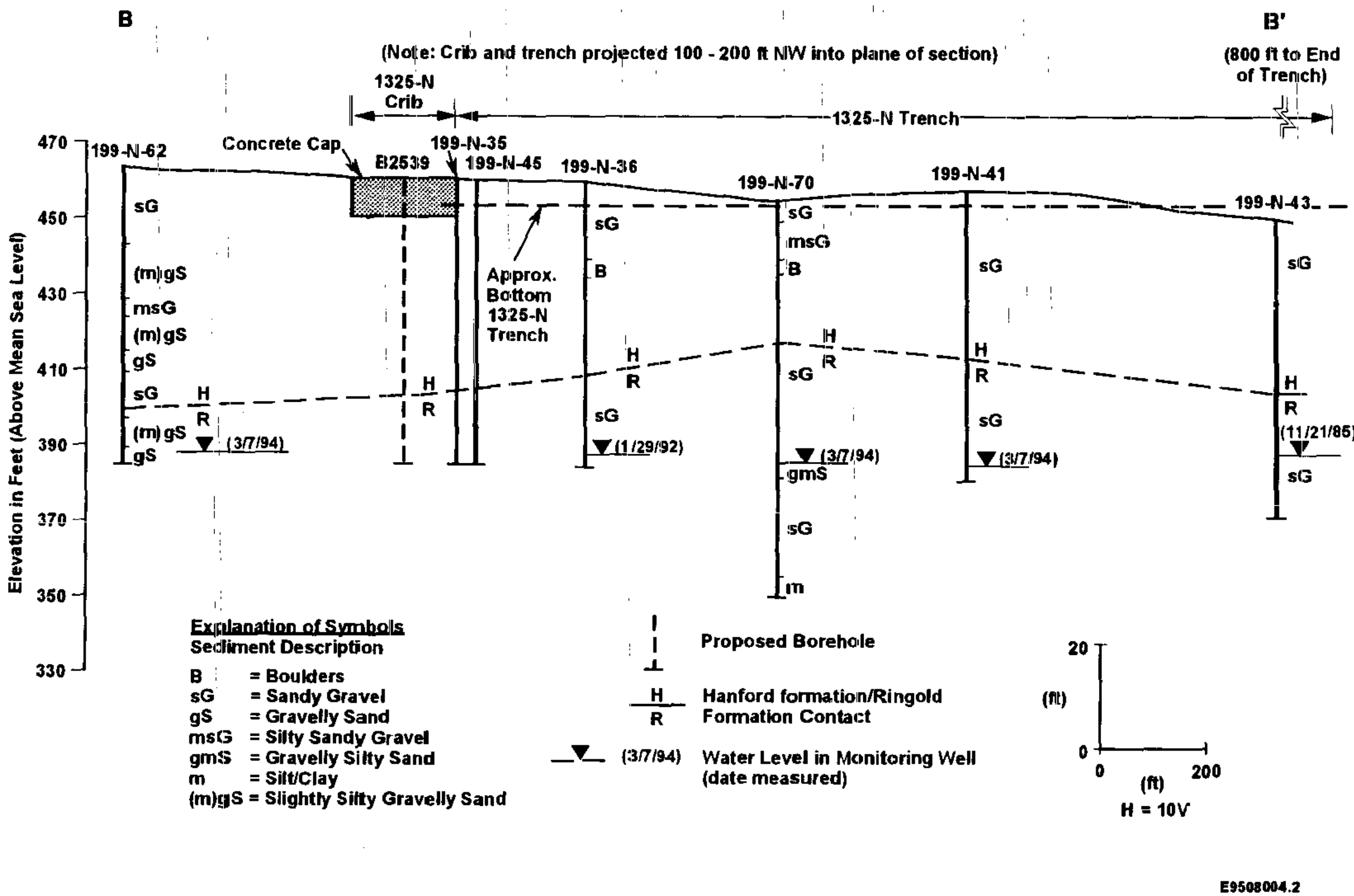


Figure 3. Geologic Cross-Section B-B' for 1325-N Liquid Waste Disposal Facility.

- BHI-SH-01, *Environmental, Safety, and Health Programs* (BHI 1995d)
- BHI-SH-02, Volumes 1 through 4, *Safety and Health Procedures* (BHI 1995f)
- BHI-EE-01, Volumes 1 and 2, *Environmental Investigations Procedures* (BHI 1995c)
- Site-specific health and safety plan/radiation work permits/job safety analysis.

## 2.2 PREREQUISITES

The requirements and procedures applicable to the 100-NR-1 Operable Unit field activities are specified in various Bechtel Hanford, Inc. (BHI) procedures, engineering specifications, and Westinghouse Hanford Company (WHC) procedures.

Applicable Environmental Investigation Procedures (EIPs) (BHI 1995c) include the following:

- EIP 1.5, "Field Logbooks"
- EIP 1.6, "Surveying"
- EIP 1.8, "Well Characterization and Evaluation"
- EIP 2.0, "Sample Event Coordination"
- EIP 3.0, "Chain of Custody"
- EIP 3.1, "Sample Packaging and Shipping"
- EIP 3.2, "Calibration and Control of Monitoring Instruments"
- EIP 4.0, "Soil and Sediment Sampling"
- EIP 4.0, Appendix B, "Split-Spoon Sampling Method"
- EIP 6.0, "Documentation of Well Drilling and Completion Operations"
- EIP 6.2, "Field Decontamination"
- EIP 7.0, "Geologic Logging."

Applicable field support (BHI 1995e) procedures include the following:

- Section 4.0, "Waste Management."

Applicable engineering specifications (BHI 1995g) include the following:

- BHI-SPEC-C-00008, *Technical Specifications for Environmental Drilling Services.*

Applicable Environmental Investigations Instructions (EIIs) (WHC 1988) include the following:

- EII 5.5, "Laboratory Cleaning of RCRA/CERCLA Sampling Equipment"
- EII 5.7A, "Hanford Geotechnical Sample Library Control"
- EII 11.1, "Geophysical Logging."

Each item on the Drilling Planning Form will be signed and dated by the cognizant engineer or field team leader (FTL) in accordance with EIP 6.0, "Documentation of Well Drilling and Completion Operations" (BHI 1995c), prior to start of work. Each item on the checklist will be signed and dated by the cognizant engineer or FTL prior to start of work.

## 3.0 FIELD ACTIVITIES

This DOW is applicable to the 100-NR-1 Operable Unit. The work scope consists of drilling, sampling, and geophysical logging of three characterization boreholes at the 1301-N LWDF, and geophysical logging of three additional groundwater monitoring wells near the 1301-N and 1325-N LWDFs.

Borehole B2536 will be drilled within the 1301-N crib, while boreholes B2537 and B2539 will be drilled immediately adjacent to the 1301-N trench and 1325-N crib, respectively. Construction of drill pads will require the placement of clean fill and grading in the work area. Prior to pad construction at the B2536 borehole location, a 40.6-cm (16-in.) diameter starter casing will be installed using a backhoe to remove boulders and other debris that may impede sampling at the base of the 1301-N crib. A radiologically regulated cable-tool drilling rig will be used to drill and sample the characterization boreholes with split-spoon sampling and drive-barrel drilling techniques.

For borehole B2536, it is expected that concentrations in the top 1.5 m (5 ft) below the base of the 1301-N crib should be in the $\mu$Ci/g range for $^{60}$Co and $^{137}$Cs, the nCi/g range for $^{90}$Sr, and the pCi/g range for $^{239/240}$Pu. Concentrations below the high-contamination zone are expected to decrease with depth from pCi/g to low pCi/g ranges. It has been estimated that the contact exposure rate from the top layer of soil could be from 500 to 2,000 mR/h. The current exposure rate in the general work area is about 1 mR/h.

For borehole B2537, little, if any, horizonal spreading of contamination in the upper elevations of the soil column is anticipated. The expected soil concentration of radiological contaminants of concern in the upper 4.6 m (40 ft) of borehole B2537 should be in the low pCi/g range. The highest concentrations (still pCi/g) will likely be found in the 12- to 21-m (40- to 70-ft) depth interval. However, if lateral spreading has occurred, elevated concentrations (still pCi/g) may be present starting at approximately 15 ft bgs. The current exposure rate in the general work area is about 1 mR/h.

The subsurface distribution of $^{60}$Co, $^{137}$Cs, $^{90}$Sr, and $^{239/240}$Pu at the 1325-N LWDF should be similar to the distribution beneath the 1301-N LWDF. Borehole B2539 is expected to encounter moderate to high pCi/g levels of all four radionuclides starting at the base of the crib structure, approximately 2 m (7 ft) bgs. Concentrations of $^{60}$Co, $^{137}$Cs, and $^{239/240}$Pu should rapidly decrease to the low to very low pCi/g range below this depth. Concentrations of $^{90}$Sr are expected to remain in the pCi/g range, but generally decrease with depth. The current exposure rate in the general work area near the 1325-N crib is approximately 2 mR/h. Engineered barriers will be used to reduce the exposure to workers during drilling and sampling activities.

All field activities described in this DOW will be conducted in the vicinity of the 1301-N and 1325-N LWDFs. This area has been previously disturbed by past waste management activities and has been stabilized. Natural resources in this area are in a state of recovery with a mix of new and native plant species. No plant or animal species of concern were observed in the general work area. In addition, no cultural resources are anticipated to be impacted due to the previously disturbed nature of the work area. Staging areas and large equipment will be confined to existing roads and disturbed areas. The drilling of the characterization boreholes and geophysical logging of existing wells at the 1301-N and 1325-N LWDFs has little potential for causing additional adverse impacts to the existing ecological and cultural resources. Complete ecological and culture resource reviews for this LFI are found in Appendices C and D, respectively.

## 3.1 SOIL SCREENING

Field screening measurements of radioactivity associated with soils removed from the characterization boreholes will assist in selection of supplementary sample intervals. All samples and cuttings from the boreholes will be field screened by the site geologist or radiological control technician (RCT) using portable scintillation counters. The field screening instruments will be used, maintained, and calibrated consistent with manufacturer's specifications and other approved procedures. The site geologist will record all field screening results in the borehole log. Field screening methodology and instrumentation is described in detail in the Sampling and Analysis Plan (SAP) (Appendix E).

## 3.2 DRILLING ACTIVITIES

This section describes the general drilling activities that will be conducted at each drill site. All drilling will be conducted utilizing the specifications and guidance presented in the *Washington Administrative Code* (WAC) 173-160, Part Three--"Resource Protection Wells," BHI-SPEC-C-00008, *Technical Specification for Environmental Drilling Services* (BHI 1995g), and EIPs (BHI 1995c).

### 3.2.1 Drilling Method and Borehole Design

The characterization boreholes will be drilled using the cable-tool method. Drilling operations will be conducted according to EIP 6.0, "Documentation of Well Drilling and Completion Operations," and EIP 5.4, "Field Decontamination" (BHI 1995c). Boreholes will be advanced using the drive-barrel technique. The drive barrel will be limited in length so that the boreholes are advanced no more than 0.75 m (2.5 ft) before requiring the drive barrel to be emptied at the surface. Hard-tool drilling will be avoided except in those cases where the drive barrel or casing cannot be advanced due to the presence of boulders or consolidated geologic strata. Should hard-tool drilling be required, the volume of water added to the borehole will be minimized and closely monitored by the site geologist. The site geologist will record in the borehole log the volume of water added and the interval over which hard-tool drilling was required.

All boreholes will be drilled to the top of the water table, located at approximately 21.5 to 23 m (70 to 75 ft) bgs. The site geologist will determine when drilling should be terminated, based on the observation of soils saturated with groundwater. Three strings of casing will be used to downsize the borehole diameter at each borehole to minimize slough in the borehole and limit vertical downward transport of contaminants in the vadose zone during drilling operations. The casing sizes are 25.4, 20.3, and 15.2 cm (10, 8, and 6 in.) diameter. The first string of drilled casing for borehole B2536 will be installed at least 1.5 m (5 ft) below the estimated base of the 1301-N crib, or approximately 6.1 m (20 ft) bgs. The first string of casing for borehole B2537 will be installed at least 1.5 m (5 ft) below the projected base of the 1301-N trench, or approximately 6.1 m (20 ft) bgs. For borehole B2539, the first string of casing will be installed approximately 1.5 m (5 ft) below the base of the crib structure, or approximately 3.75 m (12 ft) bgs. The casings will be downsized ("telescoped") as contamination concentrations decrease as determined from field screening measurements on drill cuttings and samples. The second string of casing will be extended no deeper than approximately

18 m (60 ft) bgs. The final string of casing will be extended to total depth of approximately 21.5 to 23 m (70 to 75 ft) bgs. Figure 4 illustrates the preliminary design for both boreholes. Spectral gamma-ray and neutron moisture logging will be performed prior to telescoping of casings. Deviations from the preliminary borehole designs may be warranted based on field conditions encountered during drilling. The FTL will be permitted to implement design changes after consultation with, and approval of, the project team leader and project technical representative. Should perched groundwater conditions be encountered, drilling will be discontinued, and Ecology and EPA will be informed as to the appropriate plan of action to be taken by RL and the ERC.

All waste generated as a result of the soil borehole investigation activities will be handled in accordance with BHI-FS-01, Section 4.0, "Waste Management" (BHI 1995e), the project Waste Control Plan, and project-specific waste handling procedures. All drill cuttings will be collected in appropriate containers that identify the borehole number, activity level, and footage interval. Drill cuttings that are "hot" will be placed in appropriate containers that identify the borehole number, container surface activity levels, and footage interval. Containers containing "hot" cuttings will be placed into a radiological controlled area. Chain-of-custody documentation and procedures per EIP 3.0, "Chain of Custody" (BHI 1995c), will be applied to samples stored onsite until the materials are consumed during analyses or tests, or dealt with in accordance with Section 4.0 of BHI (1995e) with concurrence from Ecology and EPA.

Chemical/radionuclide and discrete physical properties samples will be collected from each characterization borehole using a split-spoon sampler or directly from drive-barrel drill cuttings in accordance with EIP 4.0, "Soil and Sediment Sampling" (BHI 1995c). Archive samples will be collected from the split-spoon sampler or directly from drive-barrel drill cuttings at each sampling interval after the chemical/radionuclide and discrete physical properties samples are collected in accordance with EIP 4.0 (BHI 1995c).

All geologic materials removed from the boreholes will be logged by the site geologist in a borehole log according to EIP 7.0, "Geologic Logging" (BHI 1995c). The borehole log will include the lithologic description, sample code, and depth; Hanford Environmental Information System (HEIS) numbers for each sample interval; borehole construction characteristics; screening results; and any general information the site geologist believes is pertinent to the characterization of the subsurface lithology. Each log sheet should contain no more than 6 m (20 ft) of stratigraphic information.

All boreholes will be geophysically logged using the spectral gamma-ray and neutron moisture sondes per Section 5.1.1.5.5 of the 100-NR-1 Operable Unit Work Plan (DOE-RL 1994), EII 11.1, "Geophysical Logging" (WHC 1988), or other approved logging procedures. The geophysical survey will be run in the borehole whenever the casing is to be telescoped to a smaller diameter. In addition, high-resolution spectral gamma-ray logging will be conducted over the entire length of the borehole after final depth is achieved.

### 3.2.2 Borehole Abandonment

Boreholes will be abandoned per EIP 6.0, "Documentation of Well Drilling and Completion Operations" (BHI 1995c). A detailed borehole abandonment plan will be prepared and submitted to Ecology and EPA for concurrence. Abandonment will include the construction of a survey monument at each borehole location. Surveying will be performed in accordance with EIP 1.6, "Surveying" (BHI 1995c). The survey monument will consist of a cement pad with an inlaid brass marker on

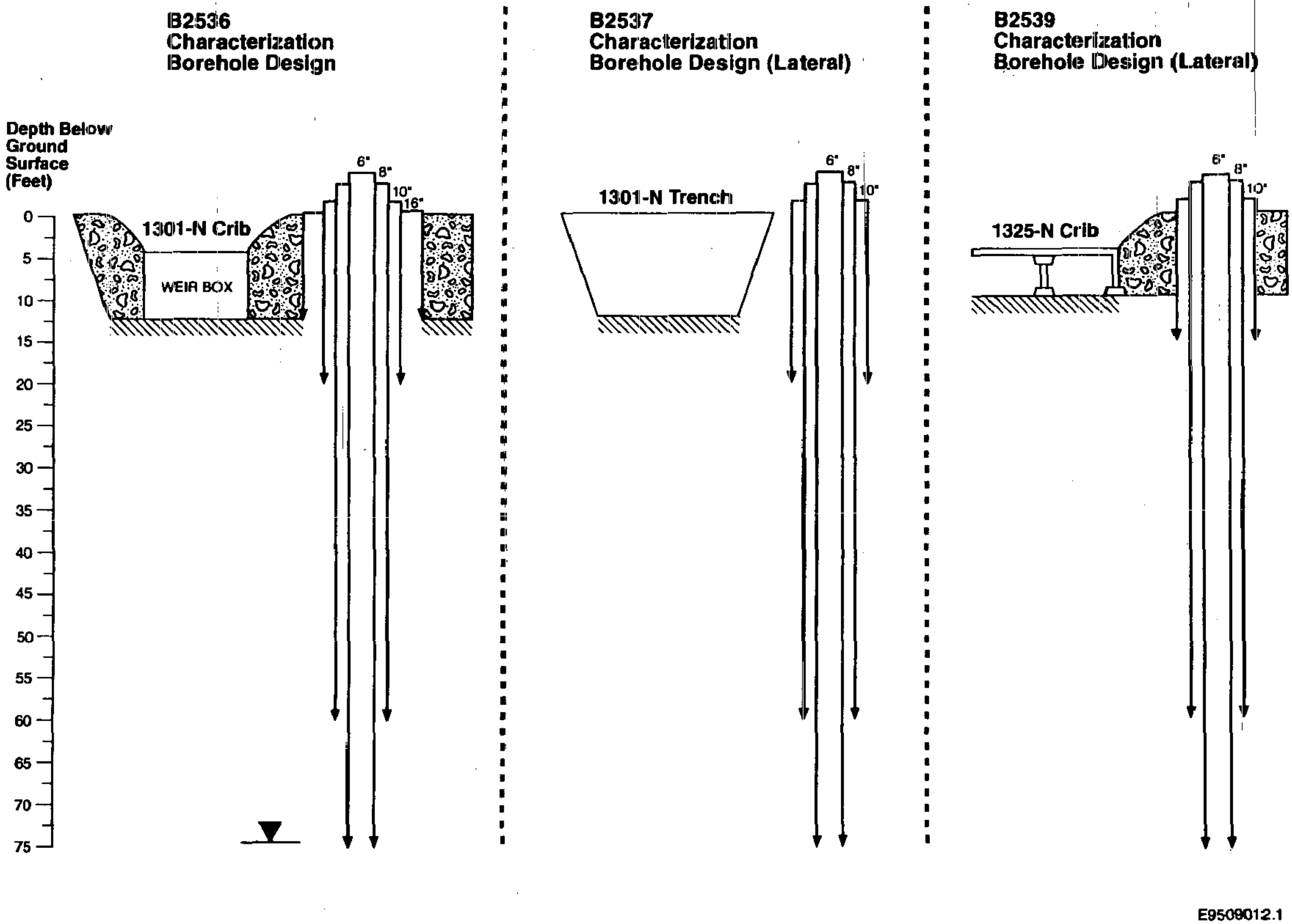


Figure 4. Preliminary Characterization Borehole Designs.

which the borehole identification number has been stamped. The brass marker will be surveyed to Washington State Plane Coordinates for location and NAVD88 for elevation. All survey data will be reported in meters.

## 3.3 SOIL SAMPLING

This section summarizes the details of the SAP presented in Appendix E. A limited number of chemical/radionuclide and physical properties samples will be collected from each characterization borehole using the split-spoon sampler and analyzed for the constituents and parameters listed in Table 1. In addition, a greater number of grab samples will be collected directly from the cable-tool drive barrel for radionuclide analysis, physical property analysis, archiving, and field screening purposes.

### 3.3.1 Analytical Soil Sampling

Soil samples for chemical, physical, and radiological analysis will be collected following guidance provided by the 100-NR-1 Operable Unit RFI/CMS Work Plan (DOE-RL 1994) and EIP 4.0, "Soil and Sediment Sampling" (BHI 1995c). Target sampling depths for each borehole are presented in the SAP (Appendix E). Each borehole will be sampled at four specific intervals using the split-spoon sampler. In addition, grab samples will be obtained from the drive-barrel drill cuttings at 3-m (10-ft) intervals to final depth. Field screening will be used to monitor drill cuttings obtained with the drive barrel and to identify alternate grab sampling points for radionuclide analysis not identified in this DOW. For example, if a contaminated zone occurs before a designated sampling point, a grab sample will be obtained, if the field screening criteria are exceeded. Field screening criteria for additional grab sampling are delineated in the SAP (Appendix E). Additional grab samples for radionuclide analysis may be taken if the site geologist observes significant changes in vadose zone lithology during drilling. The site geologist may also require the collection of additional split-spoon or grab samples for physical property analysis at significant changes in vadose zone lithology at boreholes B2537 and B2539.

Splits of sample intervals may be obtained for Ecology from each borehole identified before the start of drilling. Ecology personnel will work in conjunction with the FTL and the samplers to obtain sample splits. Ecology will assume responsibility that the samples are properly collected. Shipping requirements will be determined based on the total activities (i.e., if the samples are <50 pCi/g total activity, Ecology will ship; if >50 pCi/g, the ERC will ship).

**3.3.1.1 Chemical and Radionuclide Analysis.** Soil samples for characterizing chemical and radionuclide contaminants will be collected from each borehole at the intervals illustrated in Figure E-1 of the SAP (Appendix E). Container and volume requirements and quality assurance guidelines for chemical and radiological samples are presented in Tables E-1 and F-1 of the SAP and Quality Assurance Project Plan (QAPjP) (Appendices E and F). Samples collected with the split-spoon sampler will be analyzed for all constituents as specified in Table E-1 of the SAP (Appendix E). Grab samples will be analyzed only for radiological constituents as specified in Table E-1 of the SAP (Appendix E).

**3.3.1.2 Physical Property Analysis.** Samples for determining the physical properties of vadose zone soils will be collected only at boreholes B2537 and B2539 at the intervals illustrated in

Figure E-1 of the SAP (Appendix E). Sample volume and container recommendations for physical properties analyses are presented in Tables E-1 and F-1 of the SAP and QAPjP (Appendices E and F). Physical property samples requiring collection with the split-spoon sampler will be collected at intervals coincident with the chemical/radionuclide sampling intervals, and at significant changes in vadose zone lithology. These sampling intervals will be tested for bulk density, porosity, permeability, moisture content, and moisture retention. Grab samples will be collected directly from the drive-barrel cuttings and tested for grain-size distribution and moisture content. Physical properties grab samples should also be collected generally coincident with the radionuclide analysis grab sample intervals, and at significant changes in vadose zone lithology.

### 3.3.2 Archive Sampling

All geologic material removed from the characterization boreholes will be identified and described by the site geologist and summarized on the borehole log. Archive samples will be collected at 3-m (10-ft) intervals and significant changes in lithology. Archive samples will be stored at the drill site for up to 1 year in a radiologically controlled storage area.

Each archive sample will be labeled with the appropriate sample depth interval (to the nearest foot), date, and time the sample was obtained. Chain-of-custody documentation, as detailed in EIP 3.0, "Chain of Custody" (BHI 1995c), will be prepared by the site geologist. Each archive interval will be logged in the field logbook and the borehole log. Samples will be archived in sealed 1-L wide-mouth jars or double-contained plastic bags.

## 3.4 GEOPHYSICAL LOGGING

High-resolution spectral gamma-ray and neutron moisture logs will be collected from all characterization boreholes and existing monitoring wells 199-N-35, 199-N-45, and 199-N-67. Both characterization boreholes will be logged with spectral gamma-ray and neutron moisture sondes prior to telescoping of casing during drilling. In addition, a final spectral gamma-ray log will be collected over the entire length of each characterization borehole prior to abandonment. Existing wells will be logged over their entire length to groundwater using both spectral gamma-ray and neutron moisture sondes. The site geologist will record all geophysical logging runs performed at the characterization boreholes, including the depth interval of initial and repeat runs. All geophysical logging will be performed in accordance with EII 11.1, "Geophysical Logging" (WHC 1988), or other approved logging procedures.

Spectral gamma-ray logs will be used to determine and confirm the vertical distribution and concentration of all gamma-emitting radionuclides of concern down to the low pCi/g range. In addition, the spectral gamma-ray logging will ascertain the vertical distribution and concentration of other radionuclides such as $^{238}Pu$, $^{239/240}Pu$, and uranium in the pCi/g to nCi/g range. Applicable analysis methods, detection limits, and accuracy and precision requirements are presented in the SAP and QAPjP (Appendices E and F).

Neutron moisture logs will be used to determine and confirm the vertical distribution of moisture in the soil column at the 1301-N and 1325-N LWDFs. Applicable analysis methods, detection limits, and accuracy and precision requirements are presented in the SAP and QAPjP (Appendices E and F).

## 4.0 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

Quality assurance and quality control (QA/QC) requirements for this DOW are specified in the QAPjP located in Appendix F. The QA/QC requirements specified in the QAPjP are considered the minimum requirements needed to ensure that the data collected during the LFI fulfill the DQOs discussed in Section 1.1.

## 5.0 SCHEDULE

The following schedule lists the drilling dates for three boreholes at the 1301-N and 1325-N LWDFs and geophysical logging of the existing monitoring wells during FY 1995 and 1996. This schedule is subject to change, and the RL operable unit manager should be contacted for current status. An Agreement Activity Notification form will be issued at least 5 days before the start of field work.

| Location | General Drilling and Logging Dates |
|---|---|
| B2536 | Mid-September to late October 1995 |
| B2537 | Early November to mid-December 1995 |
| B2539 | Late December 1995 to February 1996 |
| 199-N-35 | Fall 1995 |
| 199-N-45 | Fall 1995 |
| 199-N-67 | Fall 1995 |

## 6.0 CHANGES TO DESCRIPTION OF WORK

Unforeseeable major changes to this DOW, such as analyzing different parameters, using different analytical methods, or changing the sampling interval, will be submitted using the Design Control Notice form (foreseeable changes will be submitted to the lead regulatory agency for approval or review prior to deviating from the DOW). Copies will be submitted to the lead regulatory agency and appropriate field personnel within 10 working days of the change.

## 7.0 REFERENCES

HSRCM, 1995, *Hanford Site Radiological Control Manual*, HSRCM-1, Rev. 2, Richland, Washington.

BHI, 1995a, *ALARA Program*, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1995b, *Data Quality Objectives Workshop Results for 1301-N and 1325-N Characterization*, BHI-00368, Rev. 0A, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1995c, *Environmental Investigations Procedures*, BHI-EE-01, Vol. 1 and 2, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1995d, *Environmental, Safety, and Health Programs*, BHI-SH-01, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1995e, *Field Support Administration*, BHI-FS-01, Bechtel Hanford, Inc., Richland, Washington.

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BHI, 1995g, *Technical Specification for Environmental Drilling Services*, BHI-SPEC-C-00008, Rev. 00, Bechtel Hanford, Inc., Richland, Washington.

DOE-RL, 1991, *Hanford Past-Practice Strategy*, DOE/RL-91-40, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1994, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-NR-1 Operable Unit, Hanford Site, Richland, Washington*, DOE/RL-90-22, Draft F, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE-RL, 1994a, *Hanford Federal Facility Agreement and Consent Order Change Packages, TPA Milestone M-16-94-01H-T1*, Washington State Department of Ecology, Olympia, Washington, U.S. Environmental Protection Agency, Region X, Seattle, Washington, and U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE-RL, 1994b, *Hanford Federal Facility Agreement and Consent Order Change Packages, Change Number M-16-94-02*, Washington State Department of Ecology, Olympia, Washington, U.S. Environmental Protection Agency, Region X, Seattle, Washington, and U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Hartman, M. J. and K. A. Lindsey, 1993, *Hydrogeology of the 100-N Area, Hanford Site, Washington*, WHC-SD-EN-EV-027, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988, *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

# APPENDIX A

## SITE CONCEPTUAL MODEL

# APPENDIX A

# SITE CONCEPTUAL MODEL

## A.1 PURPOSE OF CONCEPTUAL MODEL

A site conceptual model is needed to permit development of a clear problem statement and to understand how much data are required to make decisions relative to solving the problem. A site conceptual model for the 1301-N and 1325-N Liquid Waste Disposal Facilities (LWDFs) was developed by:

- Compiling and interpreting existing data associated with the 1301-N and 1325-N LWDFs
- Identifying data gaps
- Preparing a graphical conceptual representation of the 1301-N and 1325-N LWDFs and contaminant distribution in the subsurface, and indicating those areas or zones with no data.

## A.2 MODEL OF CONTAMINANTS PER ZONE

A generic model for the 1301-N and 1325-N LWDFs was developed for $^{60}Co$, $^{137}Cs$, and $^{90}Sr$. A vertical and horizontal profile of the crib/trenches was generated with the contaminants divided by concentration and by surface soil, vadose zone to include the old water table, and finally the current groundwater table. Although plutonium is also a contaminant of concern, existing data do not indicate that this contaminant has migrated to any significant extent beyond the 1301-N and 1325-N LWDF boundaries. As a result, no conceptualization is presented for plutonium. It is understood that future characterization efforts will include the collection of plutonium concentration data.

## A.3 DESCRIPTION OF ZONES AND CONCENTRATIONS PER ZONE

Each zone is described and illustrated by analyte in Figures A-1, A-2, and A-3. While the contaminants vary, the zone boundaries do not change. The zone descriptions are presented with summary information by contaminant. The figures show the measured and assumed concentrations by zone for $^{60}Co$, $^{137}Cs$, and $^{90}Sr$.

Zone 1 consists of the cobble and soil material in and immediately under the 1301-N and 1325-N LWDFs. The depth from surface for this zone is dependent on which facility the model is applied to. Generally, the bottom of Zone 1 is located 1.5 m (5 ft) beneath the bottom of the facility. The concentrations of the contaminants of concern will be the greatest in this zone. This is supported by the existing data available for the 1301-N and 1325-N LWDFs and the observed subsurface

Figure A-1. Conceptual Model for Cobalt-60.

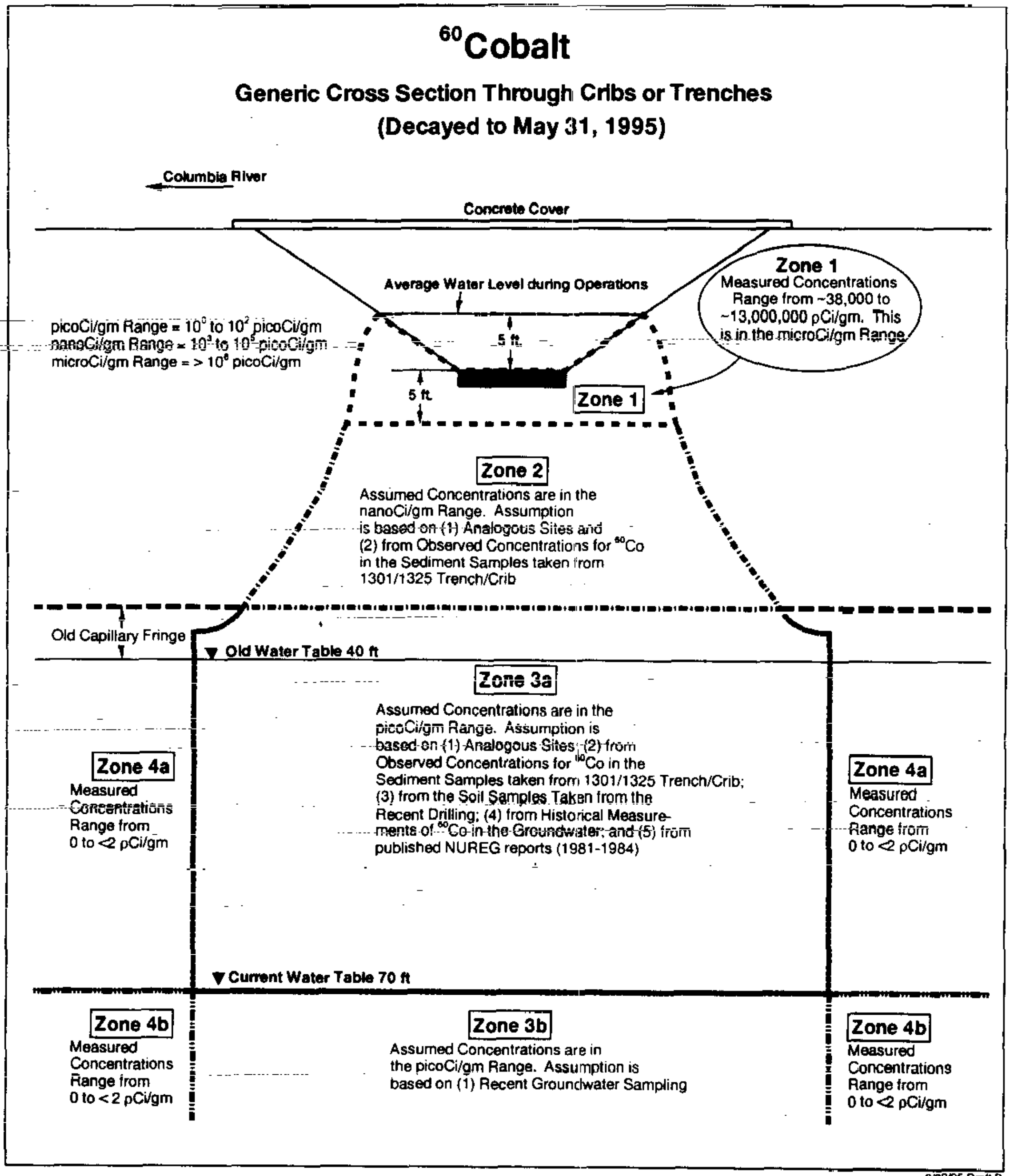


Figure A-2. Conceptual Model for Cesium-137.

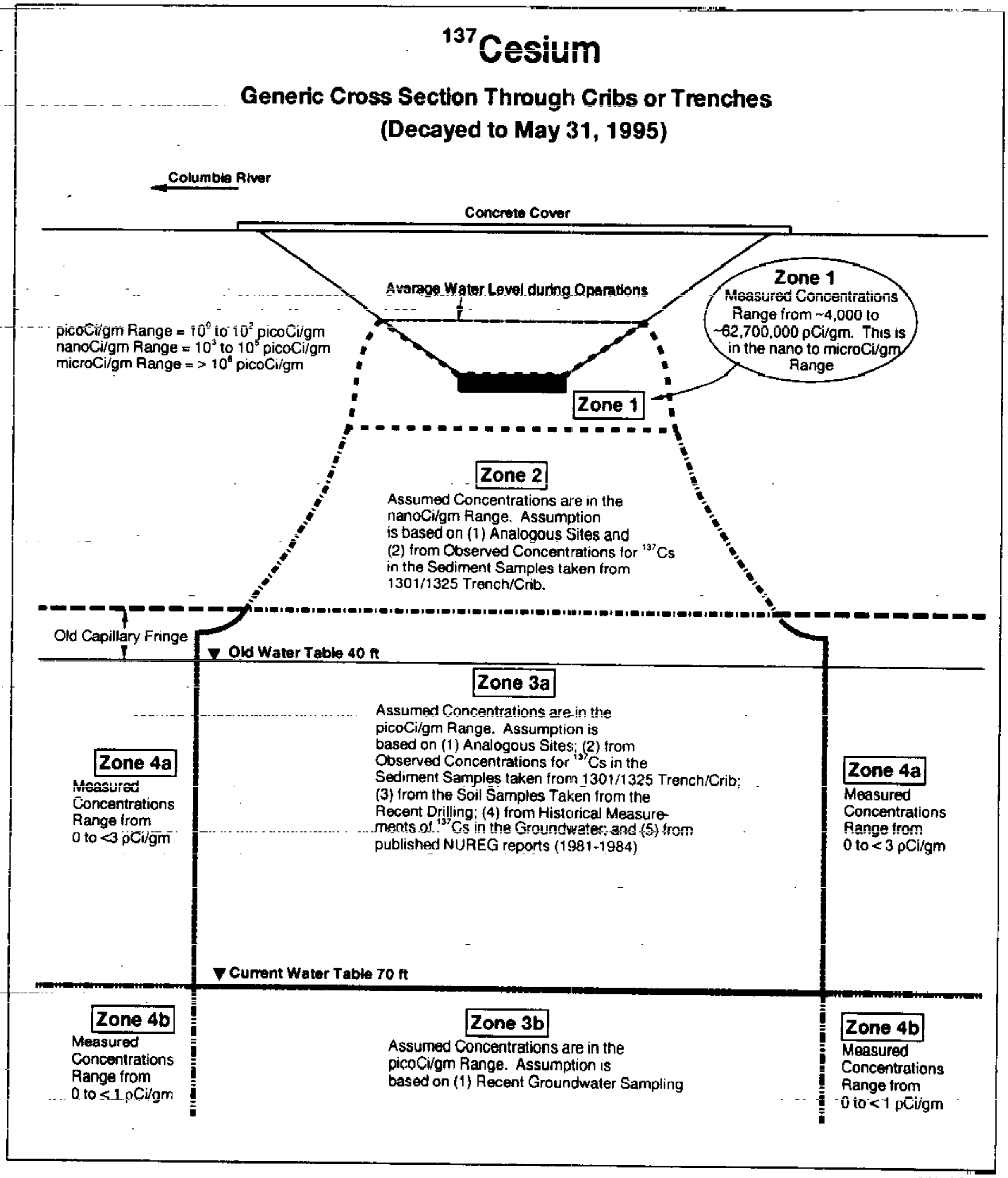
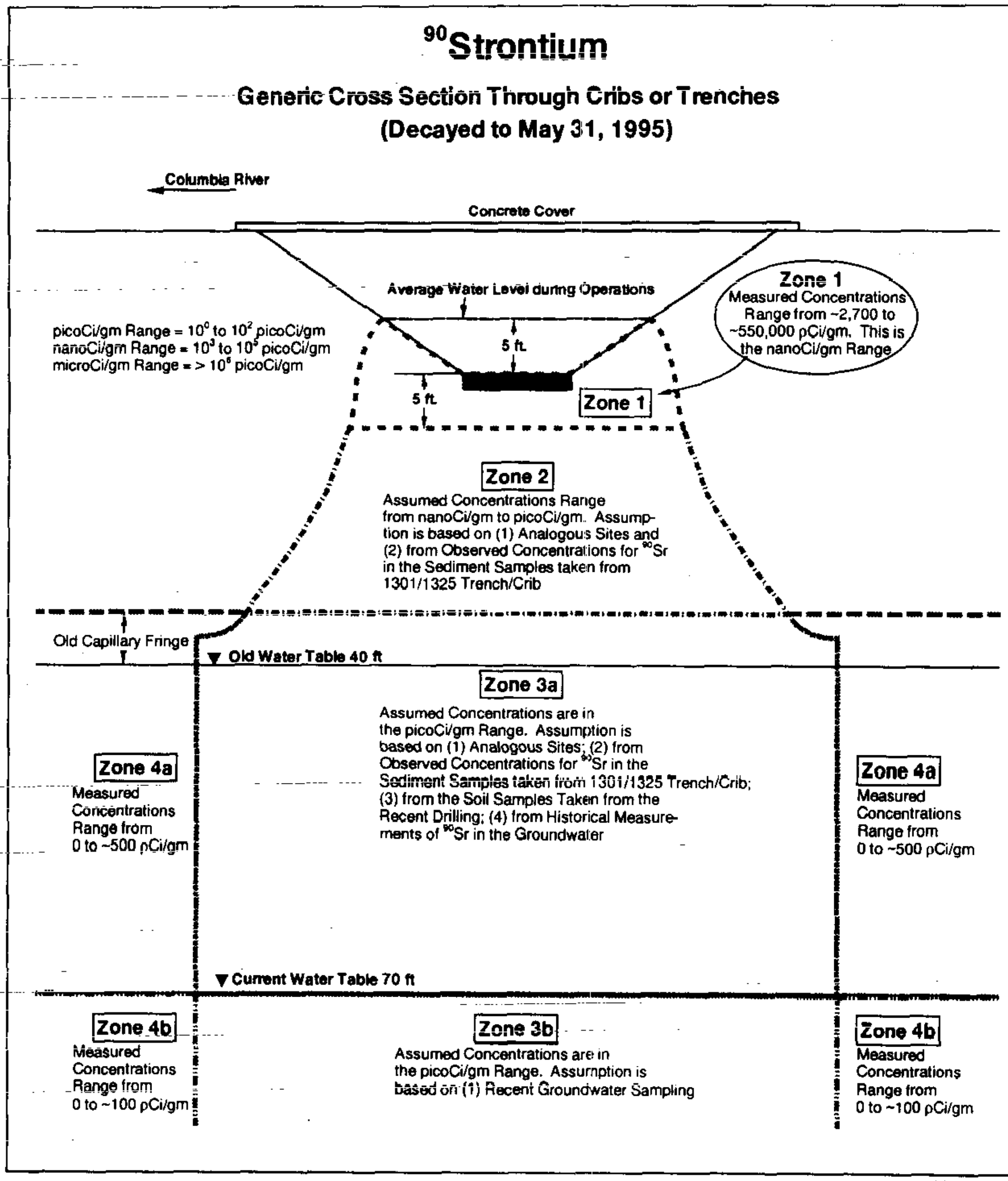


Figure A-3. Conceptual Model for Strontium-90.



distribution of these contaminants at other 100 Area facilities, which exhibited waste disposal practices and design similar to that of the 1301-N and 1325-N LWDFs. The horizontal boundary of Zone 1 is assumed to be the plan view projection of the facility boundary. All three contaminants have measured concentrations in this zone.

Zone 2 extends from approximately 1.5 m (5 ft) below the crib/trench to the capillary fringe above the operations-era groundwater table. During operation of the 1301-N and 1325-N LWDFs, the water table increased an average of 9 m (30 ft), due to groundwater mounding beneath the facilities. Since the termination of effluent disposal to the 1325-N LWDF, the water table has subsided to near static conditions. Soil data from groundwater wells in the vicinity of the 1325-N LWDF indicate that significant concentrations of $^{90}Sr$ remain stranded in the vadose zone as a result of the declining water table. Lateral spreading of the infiltrating waste water is not well defined for Zone 2. Since no direct measurements exist beneath the crib/trenches at this depth, contaminant concentrations in Zone 2 are estimated.

Zone 3a has an upper boundary of the old capillary fringe including the region between the operations-era water table and the current water table. The horizontal boundaries of Zone 3a are based on the plan view facility boundaries. This horizontal boundary is estimated and extends outside the plan view facility boundaries slightly.

Zone 3b is the unconfined aquifer saturated soils found directly beneath the 1301-N and 1325-N LWDFs. Concentrations are estimated based on groundwater data collected from monitoring wells near the 1301-N and 1325-N LWDFs.

Zone 4a is the drained vadose zone located between the operations-era water table and the current water table outside the area directly beneath the 1301-N and 1325-N LWDFs. Zone 4A encompasses the region from the 1301-N and 1325-N LWDF boundaries to the Columbia River. Measured concentrations exist for $^{90}Sr$, $^{137}Cs$, $^{60}Co$, and plutonium in this zone.

Zone 4b is the unconfined aquifer saturated soils found outside the boundaries of the 1301-N and 1325-N LWDFs. Zone 4b encompasses the region from the 1301-N and 1325-N LWDFs boundaries to the Columbia River. Measured concentrations exist for the groundwater and soils in the groundwater between the 1301-N and 1325-N LWDFs and the Columbia River. The N-Springs pump-and-treat program is remediating $^{90}Sr$-contaminated groundwater in this region.

Table A-1 outlines the general concentration levels by contaminant for each zone and indicates whether the general concentration level is based on measured or assumed concentration values.

Table A-1. Conceptual Model Concentration Summary.

| Zone | $^{90}Sr$ | $^{137}Cs$ | $^{60}Co$ |
|---|---|---|---|
| 1 | nCi/g range M | μCi/g range M | μCi/g range M |
| 2 | nCi/g range A | nCi/g range A | nCi/g range A |
| 3a | pCi/g range A | pCi/g range A | pCi/g range A |
| 3b | pCi/g range A | pCi/g range A | pCi/g range A |
| 4a | low pCi/g range M | low pCi/g range M | low pCi/g range M |
| 4b | low pCi/g range M | low pCi/g range M | low pCi/g range M |
| M = measured   A = assumed | | | |

# APPENDIX B

## DETAILED LOCATION MAPS FOR CHARACTERIZATION BOREHOLES B2536, B2537, AND B2539

017366

Environmental Restoration Contractor **ERC Team**

*Interoffice Memorandum*

Job No. 22192
Written Response Required? No
Closes CCN: N/A
OU: 100-NR-1
TSD: 1301-N/1325-N
ERA: N/A
Subject Code: 8100

| | | | | |
|---|---|---|---|---|
| TO: | G. L. Jacksha | H4-91 | DATE: | August 4, 1995 |
| COPIES: | R. C. Havenor | X1-85 | FROM: | S. J. Trent |
| | B. Mukherjee | H4-91 | | Geosciences |
| | E. F. Shorey | H4-91 | | H6-02 372-9326 |
| | K. L. Sykes | H4-91 | | |
| | BHI Document Control H4-79, w/a | | | |

SUBJECT: **1301-N/1325-N LWDF VADOSE ZONE CHARACTERIZATION REVISED BOREHOLE LOCATIONS**

REF: (1) Interoffice Memorandum from S. J. Trent to G. L. Jacksha, "1301-N and 1325-N LWDF Vadose Zone Characterization Borehole Locations," dated April 24, 1995, DCC #14537

This memorandum provides new direction regarding the number and location of characterization boreholes to be drilled in support of the 1301-N/1325-N liquid waste disposal facilities (LWDF) limited field investigation (LFI). Information contained in this memorandum supersedes that previously provided in reference (1).

The data quality objectives (DQO) process for the 1301-N/1325-N LWDF LFI was recently completed by the RL and ERC. Results of the DQO process indicate that the number of characterization boreholes can be reduced from three to two. Characterization borings at the 1301-N Crib and Trench were determined to be needed. However, the borehole at the 1325-N Crib was found not to provide any significant additional information for decision-making purposes, and therefore will likely be excluded from the current characterization effort. In addition, it was determined that the borehole located at the 1301-N Trench will be installed off to the side of the facility, rather than directly through it. The characterization borehole at the 1301-N Crib is still required to be drilled directly through the facility.

The attached set of Figures illustrate the current locations for the two characterization boreholes based on the DQO established at the RL and ERC workshop. These characterization boreholes are designated as B2536 and B2537.

Borehole B2536. The general location of this borehole is shown on Figure 1, with a detailed location illustrated on Figure 2. The borehole will be located approximately along the centerline of the long axis of the 1301-N Crib, approximately 15 feet north of the weir box. Final location of the borehole should not deviate by more than 10 feet in any direction from this approximate location. Consultation with the project coordinator and other technical staff will be required should the borehole need to be relocated beyond 10 feet of the approximate location.

017366

G. L. Jacksha
Page 2

~~Borehole 2537~~. The general location of this borehole is shown on Figure 1, with a detailed location illustrated on Figure 3. The borehole will be located at the juncture ~~of the first and second legs of the 1301-N Trench~~. The distance of the borehole from the edge of the Trench is uncertain, although it should be located as close as possible to the Trench boundary. Final location for this borehole (relative to the Trench boundary) will be determined following consultation with the project design engineers, field team leader, and project coordinator.

Borehole B2536 will be drilled first, followed by B2537. Should you have any questions, please call me on 372-9326.

SJT:dds

Attachment: Figure 1. General locations for boreholes B2536 and B2537.
Figure 2. Detailed location for borehole B2536.
Figure 3. Detailed location for borehole B2537.

RL94-104.W51/A2

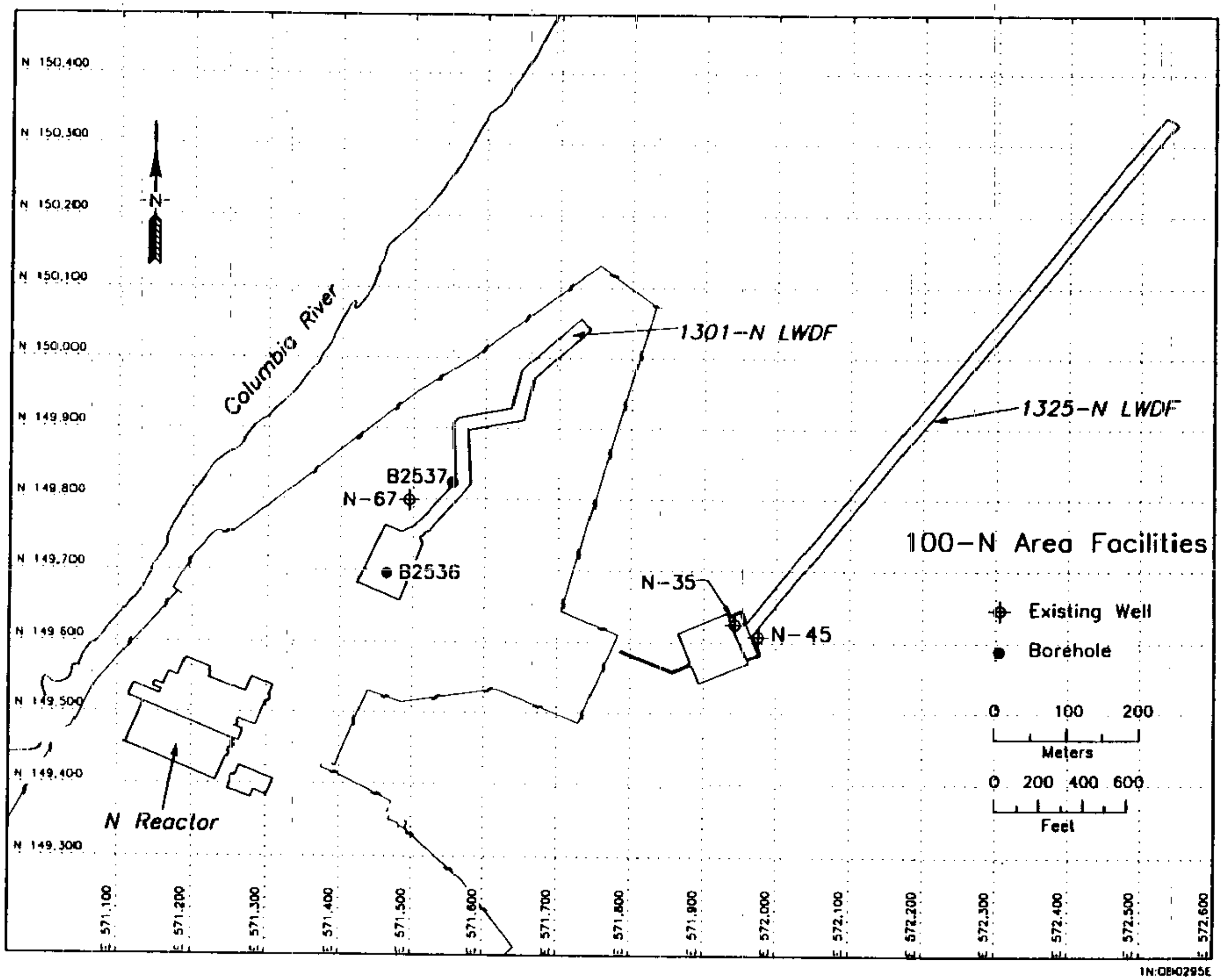



Figure 1. General locations for boreholes B2536 and B2537.

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RL94-104.W51/A2

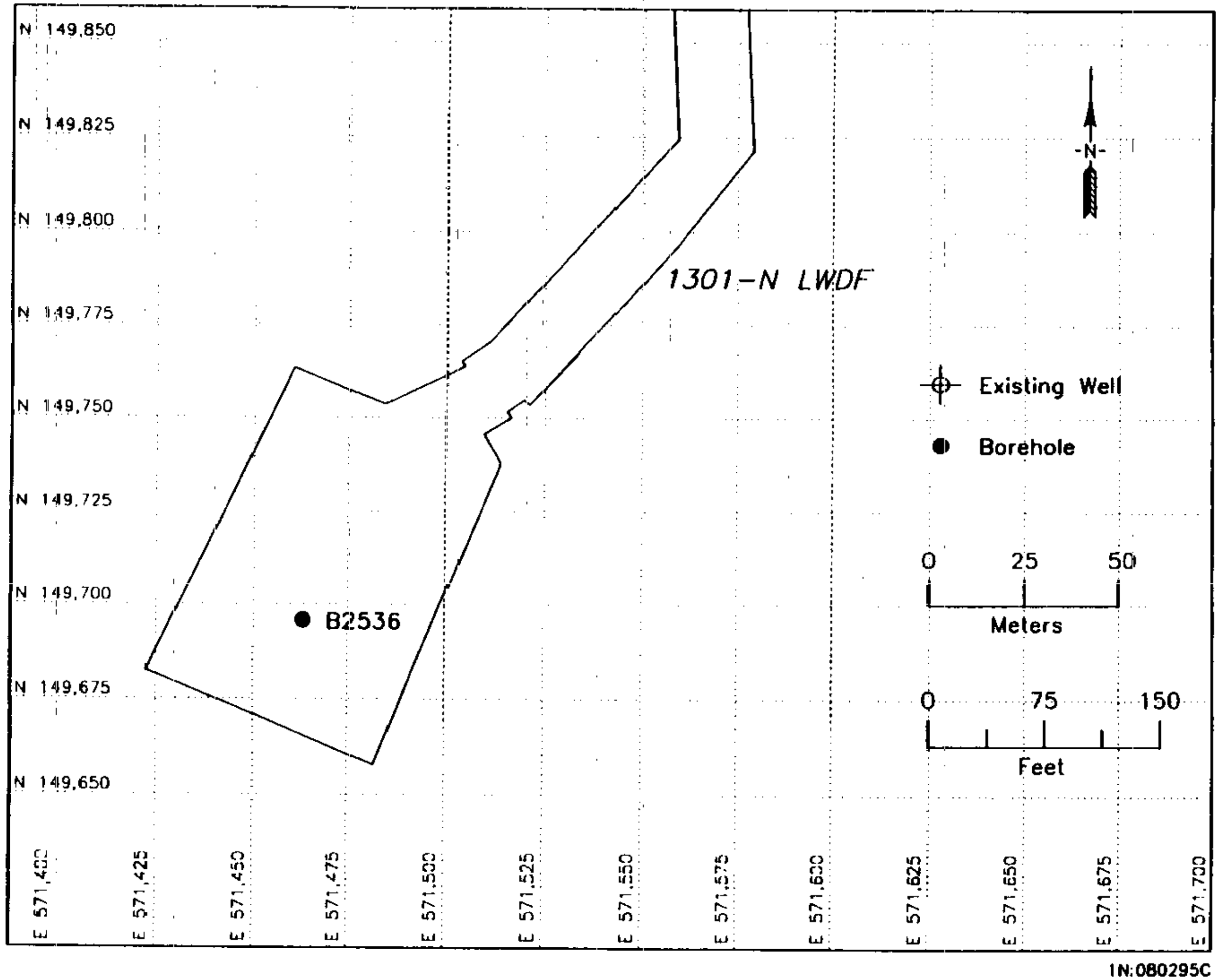


Figure 2. Detailed location for borehole B2536.

0117366

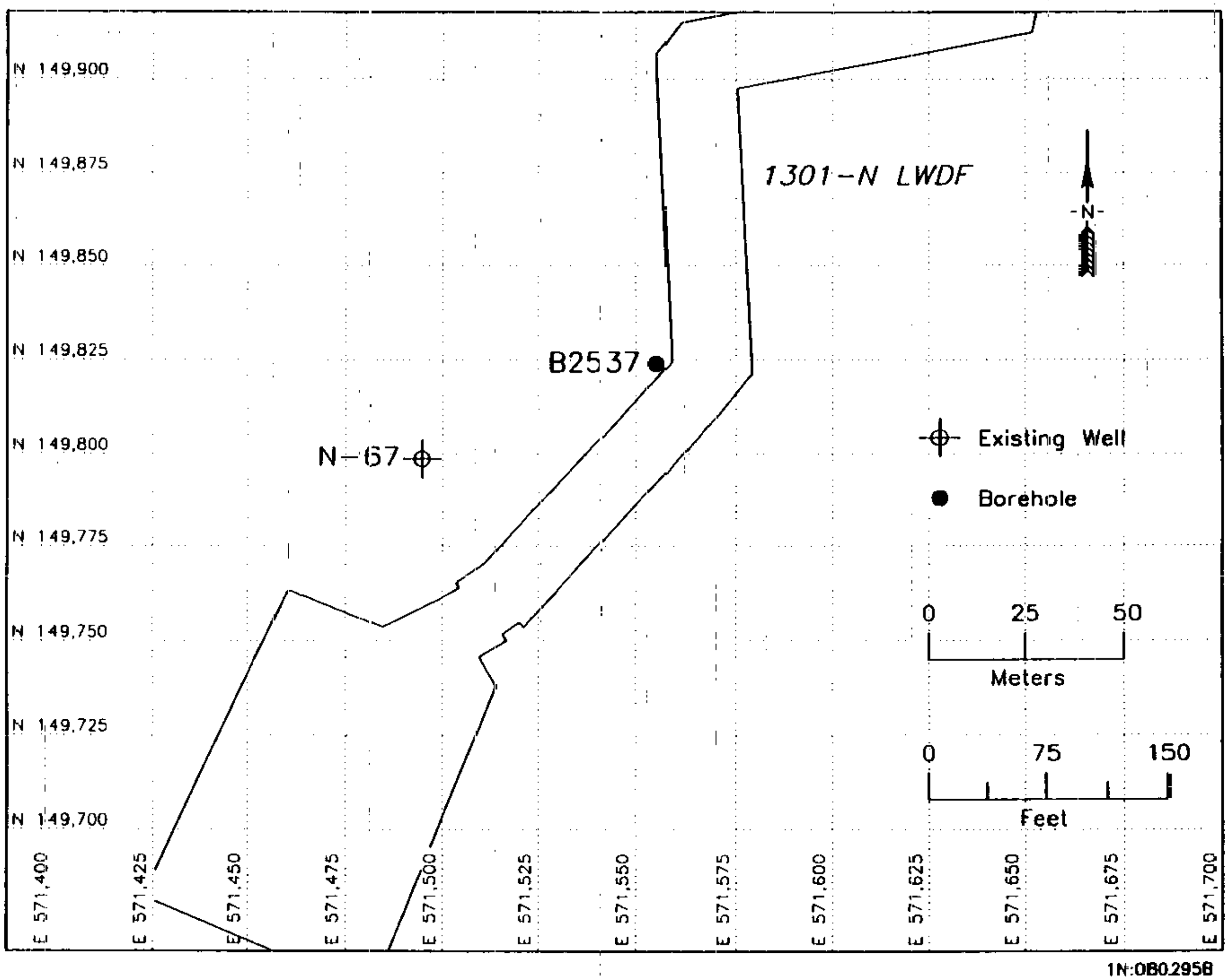


Figure 3. Detailed location for borehole B2537.





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021407

Environmental Restoration Contractor **ERC Team**

*Interoffice Memorandum*

Job No. 22192
Written Response Required? No
Close CCN: N/A
OU: 100-NR-1
TSD: 1301-N/1325-N
ERA: N/A
Subject Code: 8100

| | | | |
|---|---|---|---|
| TO: | G. L. Jacksha H4-91 | DATE: | September 6, 1995 |
| COPIES: | R. C. Havenor X1-85<br>B. Mukherjee H4-91<br>E. F. Shorey H4-91<br>K. L. Sykes H4-91<br>BHI Document Control H4-79 | FROM: | S. J. Trent<br>Geosciences<br>H6-02/372-9326 |

SUBJECT: **ADDITION OF VADOSE ZONE CHARACTERIZATION BOREHOLE AT THE 1325-N LWDF**

REF: Interoffice Memorandum from S. J. Trent to G. L. Jacksha, "1301-N/1325-N LWDF Vadose Zone Characterization Revised Borehole Locations," dated August 4, 1995, DCC #17366.

The referenced memorandum indicates that the preferred alternative for characterization of the 1301-N/1325-N LWDF includes the drilling and sampling of two characterization boreholes in and near the 1301-N LWDF. However, recent discussions between the regulatory agencies and the RL have led RL to request that the ERC drill and sample a third characterization borehole near the 1325-N LWDF. This memorandum provides the approximate location and siting requirements for this third borehole.

The attached set of Figures illustrate the general location for all three characterization boreholes, and a detailed location for the third borehole. This third borehole is identified as **B2539**. Borehole B2539 is located immediately adjacent to the northwest side of the 1325-N crib, at the midway point along the crib structure. Please note that borehole B2539 will be drilled outside of the crib structure. However, it is imperative that the borehole be located as near as possible to the crib structure as permitted by safety, health, and engineering considerations. At a minimum, the distance from the crib structure should not exceed 2.5 m (8 ft). Movement of the borehole location laterally along the crib structure should not exceed 3 m (10 ft) in either direction. Deviation from these requirements will be discussed with the project coordinator and other cognizant technical staff prior to implementation of any field changes.

Should you have any questions, please call me on 372-9326.

SJT:dds

Attachment: Figure 1. General locations for boreholes B2536, B2537, and B2539.
Figure 2. Detailed location for borehole B2539.

021407

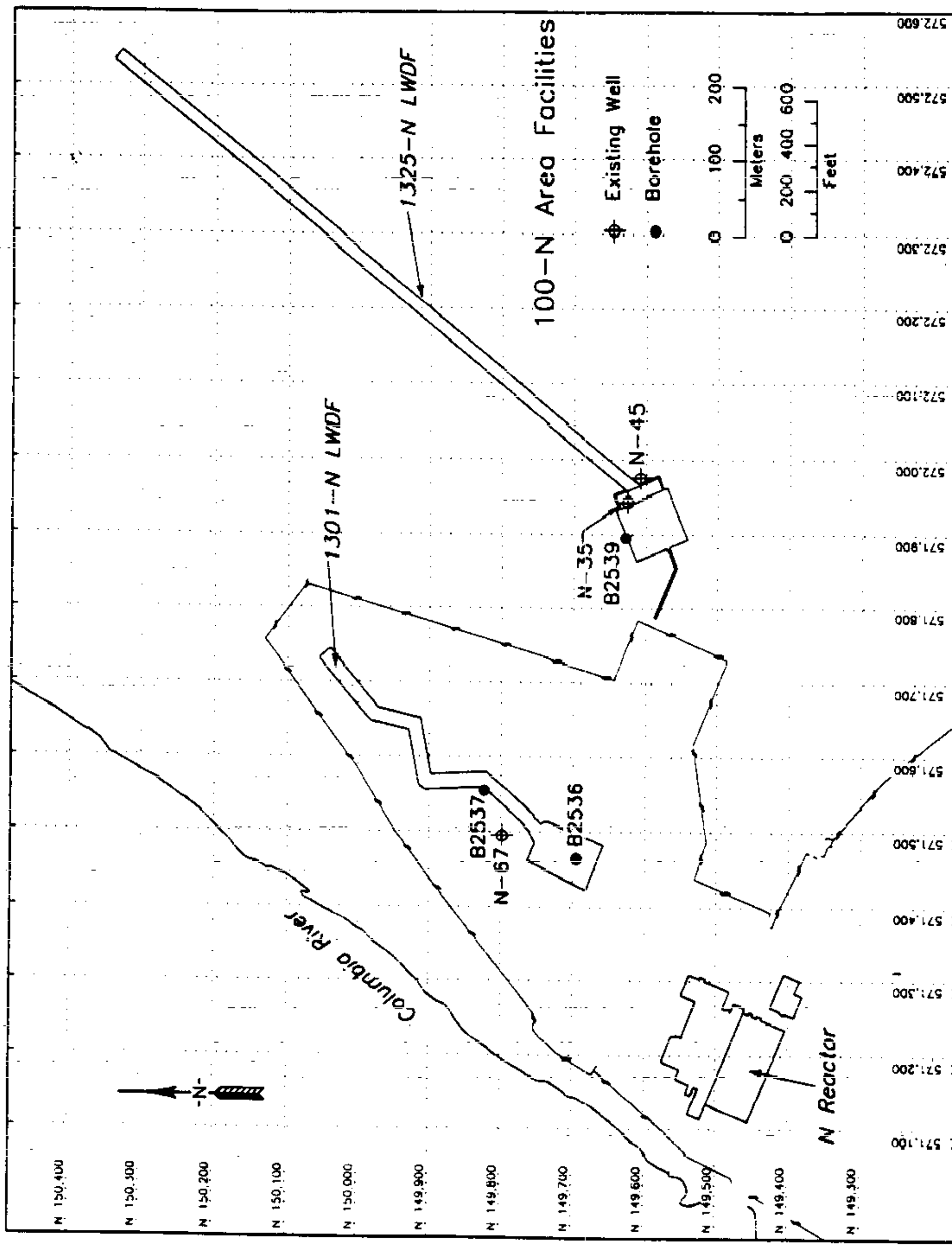



Figure 1. General locations for boreholes B2536, B2537, and B2539.

021407

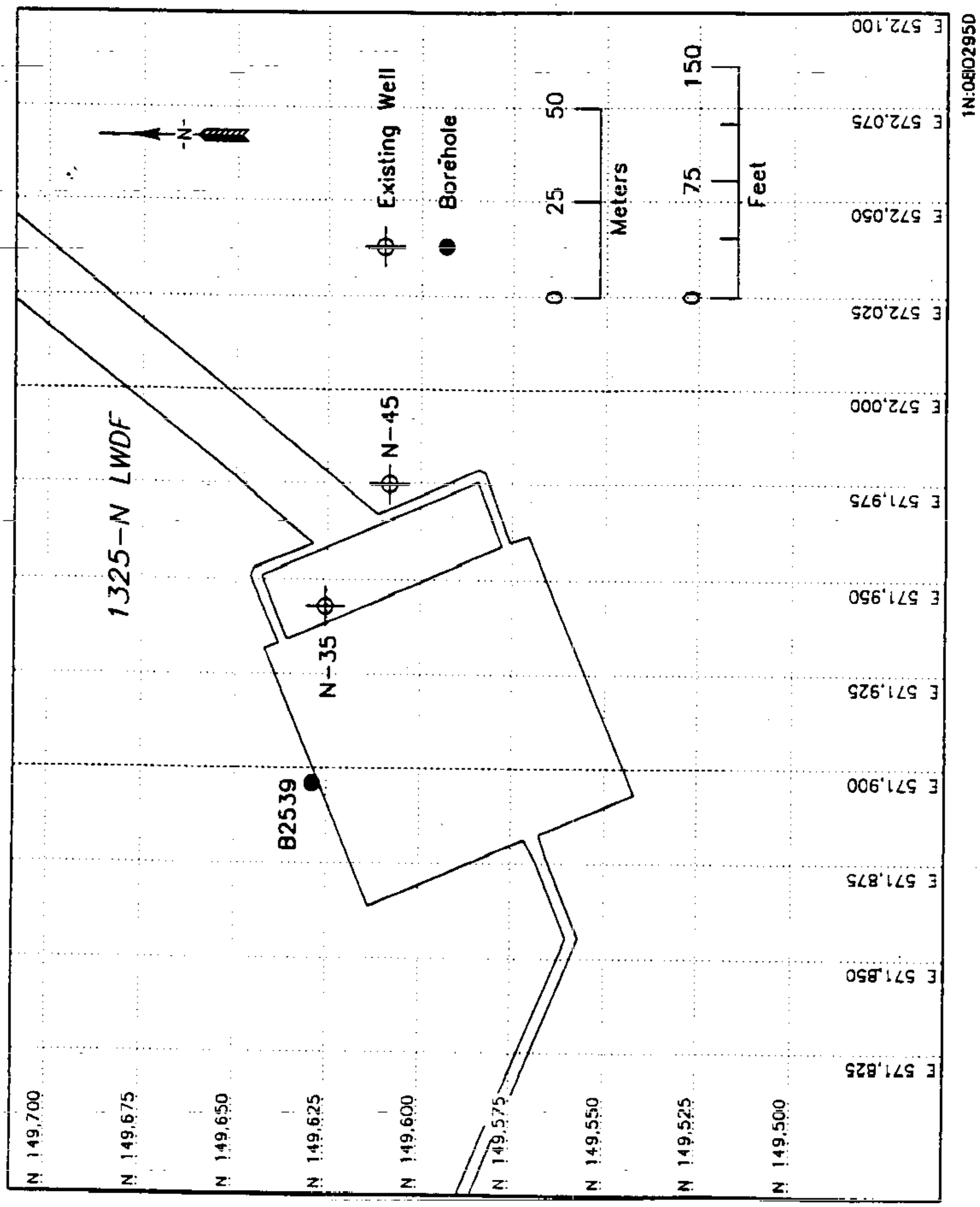



Figure 2. Detailed location for borehole B2539.

# APPENDIX C

# CULTURAL RESOURCES ASSESSMENT

014599

Environmental Restoration Contractor **ERC Team**

*Interoffice Memorandum*

Job No. 22192
Written Response Required? NO
Close CCN: N/A
OU: N/A
TSD: N/A
ERA: N/A
Subject Code: 6500

TO: Steve Trent, ~~H4-82~~ H6-03

DATE: May 5, 1995

COPIES: D.C. Stapp, H6-03
T.E. Marceau, H6-02
N.A. Cadoret, K6-75
BHI Document Control H4-79

FROM: Lew Pamplin
Manager, Natural Resources
H6-07/372-9393

SUBJECT: **CULTURAL RESOURCES REVIEW - 100N 1301/1325 CRIB CHARACTERIZATION PROJECT - HCRC# 95-100-039**

In response to your request of May 1, 1995, a review was conducted for the proposed characterization project (see attached map for location). Our findings indicate that the proposed areas to be disturbed in support of the characterization effort are heavily disturbed and require no further action by Cultural Resource staff.

A previous cultural resources review of this general project area was conducted by the HCRL Cultural Resources staff in December 1994 for the N Springs Pump and Treat Project (HCRC # 95-100-022). The HCRL review indicated that the project area had been extensively disturbed by construction activities related to the 100-N mission. HCRL found that although the project area is located within 400 meters of the Columbia River, the ground has been so heavily disturbed that it is very unlikely that any archaeological material exists there. No surveying or monitoring activity efforts by a Cultural Resources Specialist were required.

Areas to be impacted by the 1301/1325 Crib Characterization Project were discussed with Randy Havenor on April 19th, 1995. Additional onsite discussions were held with Dave Baker on May 4, 1995. Areas to be impacted by this project were found to be heavily disturbed. No additional action is required by cultural resource staff.

This project (HCRC# 95-100-039) is considered Class IV: New Construction in a Disturbed, High Sensitivity Area. Although considered a high sensitivity area for cultural resources, the ground has been so heavily disturbed that it is very unlikely that any archaeological materials exist there.

All workers must be directed to watch for cultural material (e.g., bone, stone tools) during all work activities. If any cultural materials are encountered as work proceeds, work in the vicinity of the discovery must stop until a Cultural Resource Specialist has been notified, assessed the significance of

014599

Steve Treat, H6-03
Page 2

the find, notified the appropriate Tribes, and arranged for mitigation of the impact to the find (if necessary). For any discoveries, contact the Cultural Resource staff assigned to this project or Thomas E. Marceau at 372-9289.

If any changes occur relative to work scope or area to be impacted, it is important that you contact the Cultural Resources staff for additional review/action that might be required.

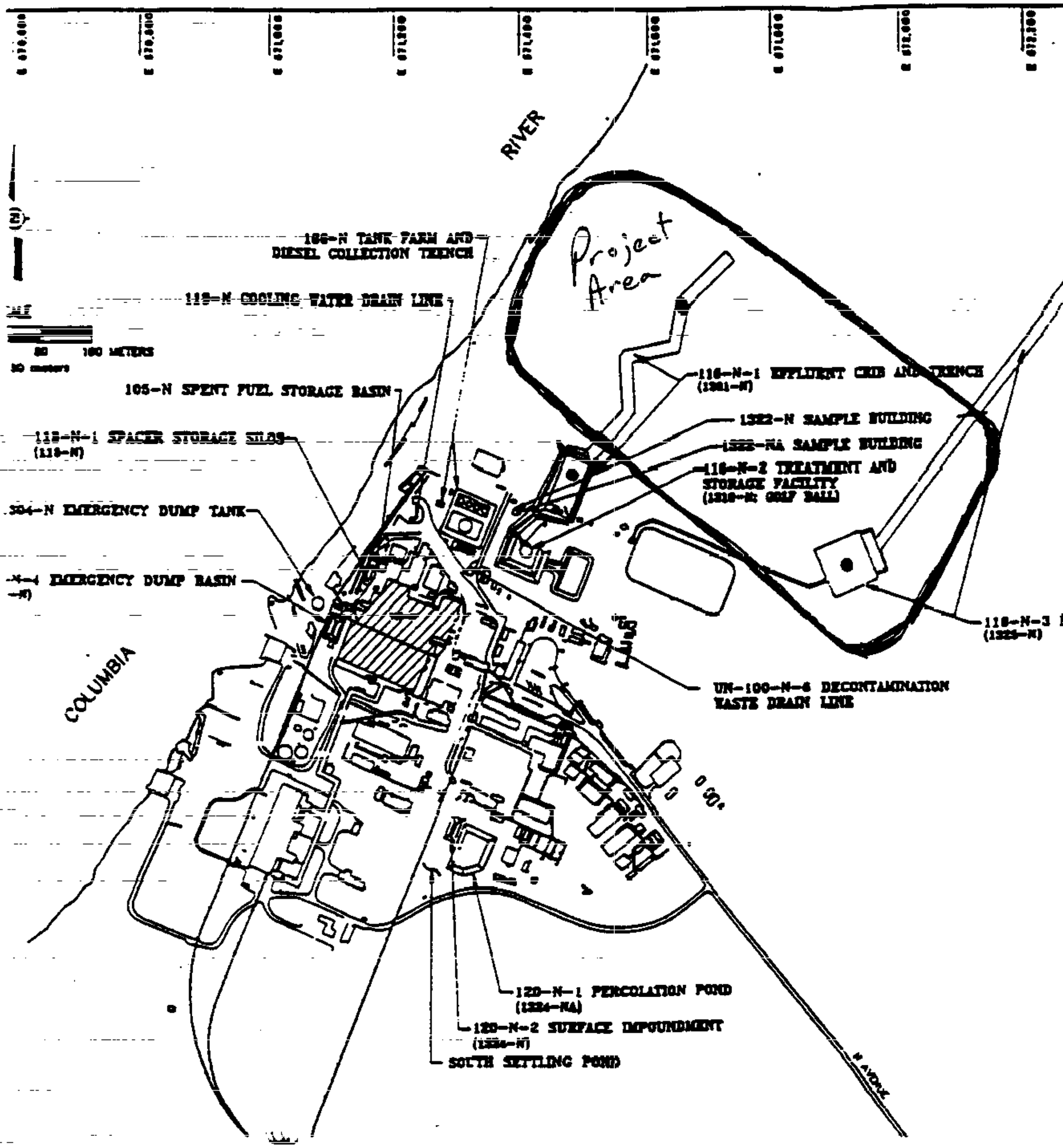
A copy of this memo will be sent to Dee W. Lloyd, Manager, Cultural Resources Program, A5-15, DOE-RL, as official documentation. Please use the HCRC# above for any future correspondence concerning this project.

Author Signature: Darby C. Stapp
Cultural Resources Coordinator

Approval Signature: Thomas E. Marceau
Cultural Resources Supervisor

014599

N Reactor 1301/1325 Characterization Project



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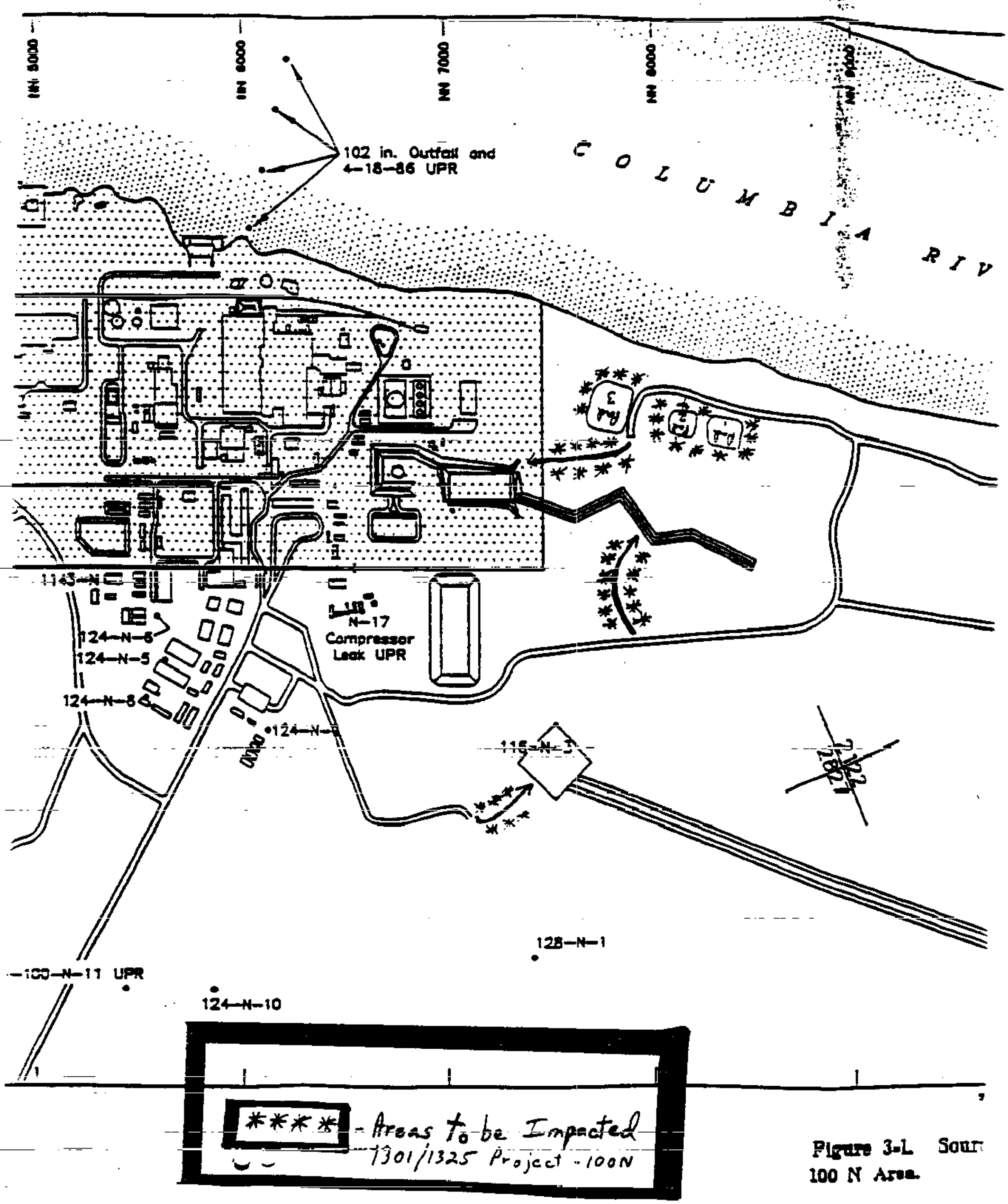


Figure 3-L. Sour
100 N Area.

917327

**Environmental Restoration Contractor ERC Team**

*Interoffice Memorandum*

Job No. 22192
Written Response Required? NO
Close CCN: N/A
OU: NR-1
TSD: N/A
ERA: N/A
Subject Code: 6500

**TO:** Randy Havenor X1-85

**DATE:** July 20, 1995

**COPIES:** J.K. Woodruff H6-01
T.E. Marceau H6-02
N.A. Cadoret K6-75
BHI Document Control H4-79
WLP:Letterbook H6-07

**FROM:** Lew Pamplin
Manager, Natural Resources
H6-07/372-9393

**SUBJECT:** **CULTURAL RESOURCES REVIEW - N SPRINGS PUMP AND TREAT (HCRC# 95-100-022b) & 1301/1325 N CHARACTERIZATION (HCRC# 95-100-039a)**

---

ERC Cultural Resource staff met with you in the field on Monday, July 17, 1995 to discuss details about new developments in the N Springs Pump and Treat and the 1301/1325 N Characterization Projects. This memorandum serves as a confirmation of the discussions and supplements the Cultural Resource Reviews already conducted.

- **N Springs Pump and Treat**
  A new proposed extraction well location for the N Springs Pump and Treat Project was observed. Its location will be on the northwest side of the existing pump and treat facility platform. Fill will be taken from the platform slope to construct a level well pad measuring 75 ft by 100 ft.

- **1301/1325 Characterization**
  Pre-existing roads will be used as access to the 1301 Crib and Trench and the 1325 Crib for the characterization drilling project. Spoil/backfill piles on each side of the 1301 trench may be used to cover the trench. No activities will take place at the 1325 Trench.

The areas in which both of these projects are located have been disturbed from previous construction activities and thus pose little potential for intact cultural resources. The Hanford Cultural Resource Management Plan classifies these activities as Class IV undertaking: New Construction in a Disturbed, High Sensitivity Area. No further action by a Cultural Resource Specialist will be required for these activities.

Because of the project locations proximity to the river and a potential Traditional Cultural Property, all workers should continue to watch for cultural materials (e.g., bone, stone tools) during all work activities. If any cultural materials are encountered, work in the vicinity of the find must stop until a Cultural Resource Specialist has been notified, contacted the appropriate Tribes, assessed the

017327

Randy Havenor X1-85
Page 2

significance of the find, and arranged for mitigation of the impact to the find (if necessary). Discoveries should be directed to Thomas E. Marceau at 372-9289.

This guidance is based upon personal communications with you on July 17, 1995. If any changes occur relative to work scope or area to be impacted, it is important that you contact the Cultural Resources staff for additional review/action that might be required. Please inform Joy Woodruff at 372-9281 when ground disturbing activities are going to take place.

Author Signature: Joy K. Woodruff
Joy K. Woodruff
Cultural Resources Specialist

Approval Signature: Thomas E. Marceau
Thomas E. Marceau
Cultural Resources Supervisor

017449

Environmental Restoration Contractor **ERC Team**

*Interoffice Memorandum*

Job No. 22192
Written Response Required? NO
Closes CCN: 014599
OU: N/A
TSD: N/A
ERA: N/A
Subject Code: 6500

**TO:** Kira L. Sykes H4-90

**DATE:** August 30, 1995

**COPIES:** J.K. Woodruff H6-01
N.A. Cadoret K6-75
S.J. Trent H6-03
T.E. Marceau H6-02
WLP: Letterbook H6-07
BHI Document Control H4-79

**FROM:** Lew Pamplin
Manager, Natural Resources
H6-07/372-9393

**SUBJECT: CULTURAL RESOURCES REVIEW - 1325-N CRIB BOREHOLE ADDITION (HCRC# 95-100-039b)**

This memo is an amendment and an addition to the original Cultural Resource Review of May 5, 1995, for the 1301/1325 Crib Characterization project. On August 29, 1995, Kira L. Sykes raised the concern that the project area indicated on our map attached to the original review memo did not represent the complete area reviewed for the project. Attached to this current memo is the amended map for clarification of the area where activities were reviewed for the project. We also received notification of an additional proposed borehole at the 1325-N Crib which was not part of the work scope we received on May 1, 1995. Our findings indicate that the proposed borehole location is in a heavily disturbed area and will require no further Cultural Resources action.

Although the area has been so heavily disturbed that potential for cultural resources is low, the project is located within an area of high cultural sensitivity. Therefore, workers must be directed to watch for cultural material (e.g., bone, stone tools) during all work activities. If any cultural materials are encountered as work proceeds, work in the vicinity of the discovery must stop until a Cultural Resource Specialist has been notified, assessed the significance of the find, notified the appropriate Tribes, and arranged for mitigation, if necessary, of the impact to the find. For any discoveries, please contact Thomas E. Marceau at 372-9289.

If any changes occur relative to work scope or area to be impacted, it is important that you contact the Cultural Resources staff for additional review/action that might be required. A copy of this memo will be sent to Dee W. Lloyd, Manager, Cultural Resources Program, A5-15, DOE-RL, as official documentation. Please use the HCRC# above for any future correspondence concerning this project.

**Author Signature:** Joy K. Woodruff
Joy K. Woodruff
Cultural Resources Specialist

**Approval Signature:** Thomas E. Marceau
Thomas E. Marceau
Cultural Resources Supervisor

Attachment: Amended Project Area Map

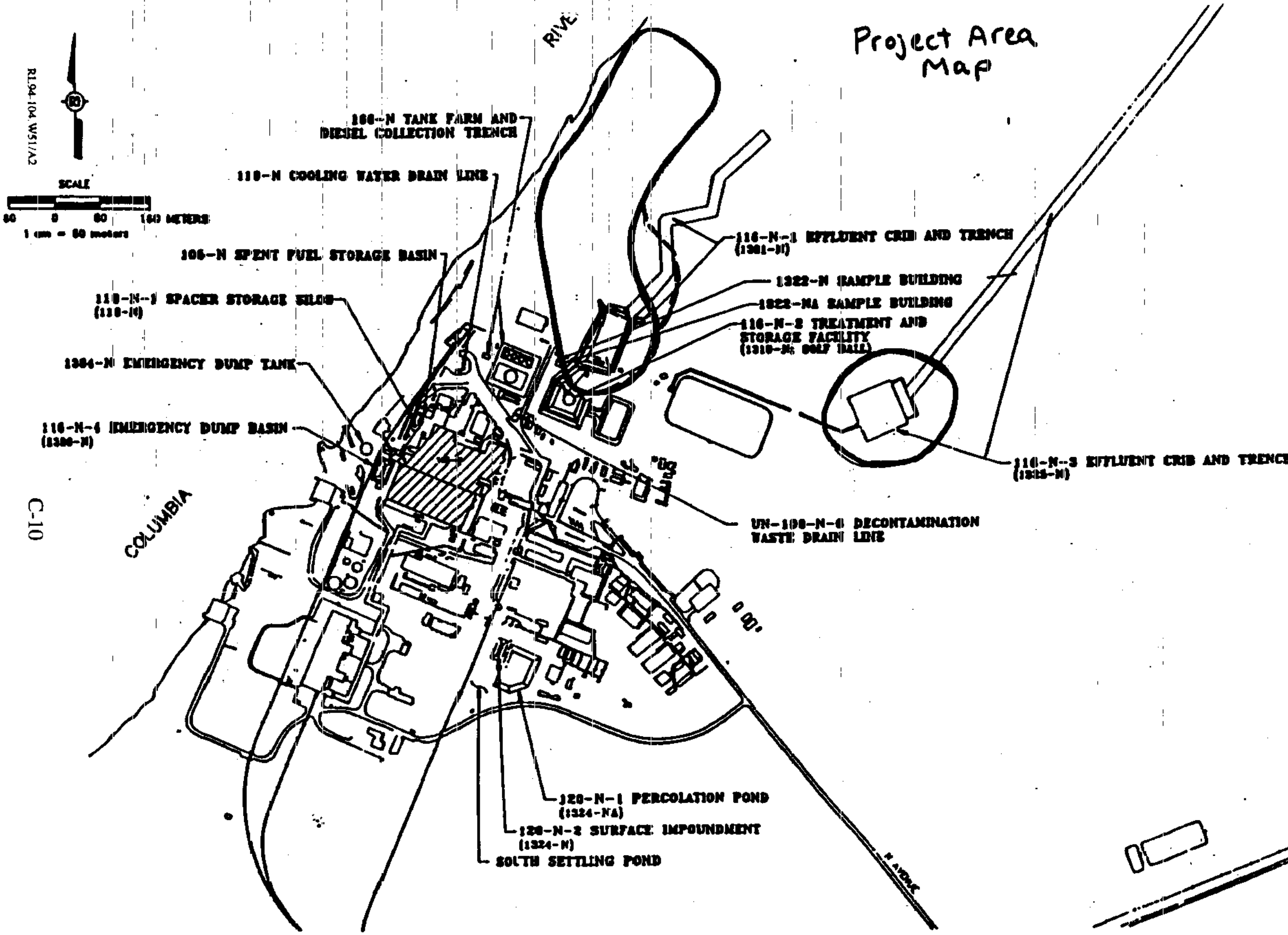


Figure C-3. Project Area Map.

# APPENDIX D

# ECOLOGICAL RESOURCES ASSESSMENT

017266

Environmental Restoration Contractor **ERC Team**

*Interoffice Memorandum*

Job No. 22192
Written Response Required? NO
Close CCN: N/A
OU: N/A
TSD: N/A
ERA: N/A
Subject Code: 6500

TO: D. D. Teel H4-89

COPIES: See Below

DATE: June 20, 1995

FROM: Lew Pamplin Rome L Marcum
Natural Resources
H6-07/372-9393

SUBJECT: **ECOLOGICAL REVIEW FOR 1301/1325 CRIB CHARACTERIZATION IN THE 100-NR-1 OPERABLE UNIT (ER-95-022)**

This memo is in response to your request for an ecological review of the 1301-N and 1325-N Cribs in the 100-NR-1 Operable Unit. These sites have been previously disturbed by past waste management activities. Most of the affected area is bounded by chain link fencing and is posted as a radiological "Surface Contamination Area."

Natural Resources staff conducted an ecological review of the area on June 9, 1995. The area is in a state of recovery and has a mix of introduced and native plant species. No plant or animal species of concern were observed at the site. Common plants observed were cheatgrass, Russian thistle, Sandberg's blue grass, Jim Hill mustard, gray rabbittbrush, and hoary aster . Wildlife species known to inhabit the area include horned larks, meadow larks, rock doves, starlings, magpies, common raven, and Great Basin pocket mice.

The installation of groundwater monitoring wells at these sites has little potential for causing adverse impacts to wildlife or habitats of concern.

If there are any major changes in the scope of planned characterization activities that could result in additional surface disturbances during this project, please contact K. A. Gano at 372-9316 and refer to the Ecological Review number given in the subject line. Thanks.

DSL:rj

Copies
K.A. Gano H6-02
R.C. Havenor N3-05
D.S. Landeen H6-01
WLP:Letterbook H6-07
BHI Document Control H4-79

# APPENDIX E

# SAMPLING AND ANALYSIS PLAN

# APPENDIX E

# SAMPLING AND ANALYSIS PLAN

## E.1 INTRODUCTION

This sampling and analysis plan defines procedures to be used for collecting and handling soil samples obtained from the B2536, B2537, and B2539 characterization boreholes and requirements for field and laboratory measurements. Deviations from these procedures may be necessary due to unforeseen circumstances that develop during the field work. Such deviations will be submitted using the Design Control Notice form described in the description of work (DOW) (Section 6.0). Deviations from procedures will be clearly noted in the field logbooks used to document sampling activities and will be included in the final sampling and analysis report included in the Limited Field Investigation Report.

## E.2 ADVANCE PREPARATION FOR SAMPLING

The selection of analytical parameters, laboratory arrangements, borehole locations, field measurement and sampling techniques, sampling equipment selection, and other quality assurance measures are based on the sampling objectives presented in the main body of the DOW. Samples will be collected from each borehole and analyzed for chemical, radiological, and physical properties. Additional soil will be collected for archival purposes. Depending on the analytical criteria, samples will be collected using a split-spoon sampler or collected from the drive barrel drill cuttings.

Sample collection techniques as detailed in this plan have been tailored to the goals of the sampling event and the individual characteristics of this site. The basis for all soil sampling is Environmental Investigation Procedure (EIP) 4.0, "Soil and Sediment Sampling" (BHI 1995). A summary of the sampling objectives and the pertinent site contaminant characteristics is found in the DOW. Discrete soil samples will be collected using split-spoon samplers and grab samples from the contents of the drive barrel. Both techniques will allow representative soil sample collection meeting the data quality objectives (DQOs) for this project.

### E.2.1 SELECTION OF SAMPLE LOCATIONS AND ANALYTICAL PARAMETERS

Analytical parameters were selected based on a review of the site history, past practices, and historical data for the 1301-N and 1325-N Liquid Waste Disposal Facilities (LWDFs) and are summarized in Table 1 of the DOW. Samples will be collected and analyzed for these parameters to further assess the vertical extent of radiological and chemical contamination by drilling borehole B2536 through the 1301-N crib and boreholes B2537 and B2539 next to the 1301-N trench and

1325-N crib, respectively. Analytical techniques were selected primarily on the basis of ability to detect potential contaminants at low levels. The DQO for the 100-N LWDFs has resulted in the following sample collection strategy.

- Use split-spoon sampling to collect discrete soil samples at depths shown in Figure E-1 for each of the boreholes. These samples are the required minimum and will be analyzed for radiological and chemical contaminants of concern as defined in Table E-1. Additional analytes may be added if detected while field screening soils.

- Use split-spoon sampling to collect discrete soils samples at depths shown in Figure E-1 for physical properties analysis from boreholes B2537 and B2539. Note that these sampling intervals generally coincide with the radiological and chemical sampling intervals. These samples are the required minimum and will be tested for physical properties listed in Table E-1. The site geologist may require collection of additional split-spoon samples at significant vadose zone lithologic changes.

- Use the drive barrel to collect grab soil samples at approximately 3-m (10-ft) intervals or at major lithology changes as shown in Figure E-1. The purpose of these samples is to supplement analytical data in between the discrete split-spoon sample depths. Grab samples will be analyzed for the radiological constituents defined in Table E-1. Additional soil will be collected for the analysis of physical properties listed in Table E-1 at 3-m (10-ft) intervals or for archival purposes.

Field screening of radioactivity associated with drill cuttings and samples removed from the boreholes will assist in selection of sample intervals. Actual sample intervals may vary from those depicted in Figure E-1.

Detection limits, analytical methods, holding times, and container/volume requirements are shown in Table E-1. These limits are at or below action levels needed to provide required data for project decisions. Volume and container requirements will be finalized by Sample Authorization Form in accordance with EIP 2.0, "Sample Event Coordination" (BHI 1995). Further discussion of sample collection and analytical requirements for each of the boreholes is found in Section E.3.

## E.2.2 SAMPLE CONTAINERS AND PRESERVATIVES

Level I EPA precleaned sample containers will be used for soil samples collected for chemical and radiological analysis. Container sizes may vary depending on laboratory-specific volumes needed to meet analytical detection limits. If, however, the dose rate on the outside of a sample jar exceeds levels acceptable by an offsite laboratory, the sampling lead and cognizant engineer can send smaller volumes to the laboratory. It is expected that only one sample at the surface of the 1301-N crib may have special volume and packaging requirements. Preliminary container types and volumes are identified in Table E-1.

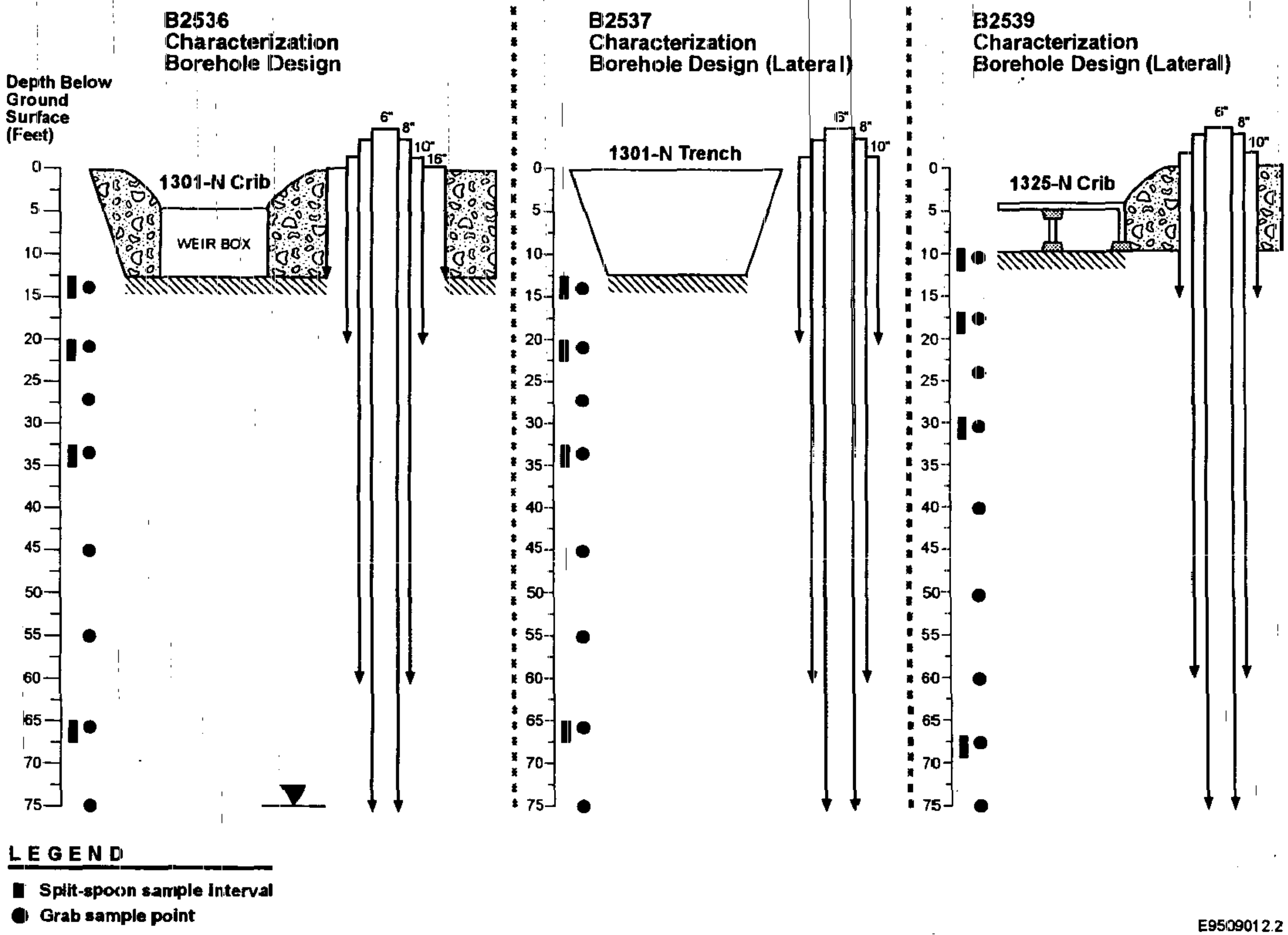


Figure E-1. Sample Collection Intervals for Boreholes.

Table E-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements. (3 Sheets)

| | Analytical Category | Analytical Parameters | Analytical Method | Detection Limit | Container Type/Volume or Mass | Maximum Holding Time |
|---|---|---|---|---|---|---|
| Split-Spoon Samples | Metals | Cadmium<br>Chromium<br>Lead<br>Nickel | SW-846;<br>Method 6010<br>ICP - Metals | 1.0 ppm | amber glass<br>40 mL | 6 months |
| | Radionuclides | Strontium-90 | Sr-02[a] | 1.0 pCi/g | amber glass<br>60 mL | 6 months |
| | | Alpha Spectrometry<br>Uranium-233/234<br>Uranium-238<br>Plutonium-238<br>Plutonium-239/240 | ASTM D 3084[b] | 0.6 pCi/g<br>(for all parameters) | | |
| | | Gross alpha | Water 901.1<br>Soil[c] | 7.0 pCi/g | | |
| | | Gross beta | Water 901.1<br>Soil[c] | 8.0 pCi/g | | |
| | | Gamma Spectrometry<br>Potassium-40<br>Manganese-54<br>Cobalt-60<br>Ruthenium-106<br>Cesium-134<br>Cesium-137<br>Cerium-134<br>Europium-152<br>Europium-154<br>Radium-226<br>Thorium-228<br>Thorium-232 | Water 901.1<br>Soil[c] | <br>10.0 pCi/g<br>0.25 pCi/g<br>0.05 pCi/g<br>1.5 pCi/g<br>0.25 pCi/g<br>0.25 pCi/g<br>0.75 pCi/g<br>0.60 pCi/g<br>0.75 pCi/g<br>4.5 pCi/g<br>0.6 pCi/g<br>0.6 pCi/g | | |
| | Offsite Shipping Requirements | For less than detectable rad samples: total activity only | 222-S Laboratory Liquid Scintillation | 50.0 pCi/g | 20 mL | 6 months |
| | | For Radioactive Samples:<br>Gross alpha<br>Gross beta<br>Gamma emitters<br>Strontium-90 | 222-S Laboratory Methods | <br>1.0 pCi/g<br>4.0 pCi/g<br>0.05 pCi/g<br>1.0 pCi/g | | |

Table E-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements. (3 Sheets)

| | Analytical Category | Analytical Parameters | Analytical Method | Detection Limit | Container Type/Volume or Mass | Maximum Holding Time |
|---|---|---|---|---|---|---|
| Split-Spoon Samples | Physical Properties | Moisture Content | ASTM D2216 (GEL-14) | N/A | moisture tin (sealed) 400 g | N/A |
| | | Moisture Retention | ASTM D2325 ASTM D3152 (GEL-18) | N/A | one 6-in. capped split-spoon liner | N/A |
| | | Bulk Density/Porosity | ASTM D2937 ASTM D4564 (GEL-14) | N/A | | |
| | | Permeability | ASTM D2434 (GEL-09) | N/A | | |
| | | Particle Size Distribution | ASTM D422 (GEL-07) | N/A | depends on grain size, one 6-in. capped split-spoon liner minimum | N/A |
| Grab Samples | Radionuclides | Strontium-90 | Sr-02[a] | 1.0 pCi/g | amber glass 40 mL | 6 months |
| | | Gross Alpha | Gas Proportional | 7.0 pCi/g | | |
| | | Gross Beta | Gas Proportional | 8.0 pCi/g | | |
| | | Gamma Spectrometry<br>Potassium-40<br>Manganese-54<br>Cobalt-60<br>Ruthenium-106<br>Cesium-134<br>Cesium-137<br>Cerium-134<br>Europium-152<br>Europium-154<br>Radium-226<br>Thorium-228<br>Thorium-232 | Gamma Spectrometry | 0.05 pCi/g (for all parameters) | | |
| | Physical Properties | Moisture Content | ASTM D2216 (GEL-14) | N/A | moisture tin (sealed) 400 g | N/A |
| | | Particle Size Distribution | ASTM D422 (GEL-07) | N/A | double-wrapped plastic bag; 1 kg minimum | N/A |

Table E-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements. (3 Sheets)

| | Analytical Category | Analytical Parameters | Analytical Method | Detection Limit | Container Type/Volume or Mass | Maximum Holding Time |
|---|---|---|---|---|---|---|
| Geophysical Logging | Radionuclides | Gamma Spectrometry | RLS | | N/A | N/A |
| | | Uranium-233 | | 150.0 pCi/g | | |
| | | Uranium-234 | | 300.0 pCi/g | | |
| | | Uranium-238 | | 25.0 pCi/g | | |
| | | Plutonium-238 | | 1.6 nCi/g | | |
| | | Plutonium-239 | | 20.0 nCi/g | | |
| | | Plutonium-240 | | 85.0 nCi/g | | |
| | | Gamma Spectrometry | RLS | | | |
| | | Potassium-40 | | 2.0 pCi/g | | |
| | | Manganese-54 | | 1.0 pCi/g | | |
| | | Cobalt-60 | | 1.0 pCi/g | | |
| | | Ruthenium-106 | | 5.0 pCi/g | | |
| | | Cesium-134 | | 1.0 pCi/g | | |
| | | Cesium-137 | | 1.0 pCi/g | | |
| | | Cerium-134 | | 5.0 pCi/g | | |
| | | Europium-152 | | 1.0 pCi/g | | |
| | | Europium-154 | | 1.0 pCi/g | | |
| | | Radium-226 | | 5.0 pCi/g | | |
| | | Thorium-228 | | 5.0 pCi/g | | |
| | | Thorium-232 | | 1.0 pCi/g | | |
| | Physical Properties | Moisture Content | Neutron Moisture Logging | 2% VFW | | |

[a]Methods specified are from the *EML Procedures Manual* (Chieco et al. 1990)

[b]Method specified is from the *1993 Annual Book of ASTM Standards* (ASTM 1993).

[c]Method shall be based on the specified water method, modified to allow measurement of the parameter of interest in a soil sample, and shall be submitted for Bechtel Hanford, Inc. review and approval prior to use.

ASTM - American Society of Testing and Materials
GEL-## - Westinghouse Hanford Company Geotechnical Engineering Laboratory
N/A - Not Applicable
RLS - Radionuclide Logging System
VFW - Volume Fraction Water

## E.2.3 SAMPLING EQUIPMENT

Sampling equipment includes the following:

- Thirteen-centimeter (5-in.) outer diameter stainless steel split-spoon sampler fitted with 15-cm (6-in.) length stainless steel or lexan liners
- Drive barrel
- Stainless steel mixing bowls, spoons, and pans
- Shielded glovebox.

## E.2.4 DECONTAMINATION AND TRANSPORT OF EQUIPMENT

All sampling-related equipment that comes into direct contact with the soil sample will be chemically decontaminated at the 1706-KE Cleaning Facility in accordance with WHC-CM-7-7, Environmental Investigations Instructions (EII) 5.5, "Sampling Equipment Decontamination" (WHC 1988), prior to use. All equipment will be handled in a manner that will minimize cross-contamination between sample locations and depth intervals. Any components of the split-spoon sampler, such as the drive head and outer split tubes, need only a soap and water decontamination. When transporting or storing cleaned sampling equipment, it will be protected in a manner that minimizes the potential for contamination. Cleaned sampling equipment will be wrapped in foil and may be stored securely at the field location.

After sample collection, equipment used for sampling will be field decontaminated with nonphosphate soap and water per EIP 6.2, "Field Cleaning and/or Decontamination of Drilling Equipment" (BHI 1995). The equipment will then be surveyed to be free of radiological contamination prior to return to the 1706-KE Cleaning Facility.

## E.2.5 FIELD DOCUMENTATION OF SAMPLING

This section describes the procedures to be followed for sample identification, field logbook entries, and chain-of-custody documentation for samples.

### E.2.5.1 Sample Identification

The Hanford Environmental Information System (HEIS) database will be used to track the sample and laboratory data obtained during this characterization. Prior to initiating field activities, a block of HEIS sample numbers will be issued to the sampling organization for this project in accordance with EIP 2.0, "Sample Event Coordination" (BHI 1995). Each chemical/radiological and physical properties sample will be identified and labeled with a unique HEIS sample number. The sample location and corresponding HEIS numbers will be documented in the sampler's field logbook.

Each sample container will be labeled with the following information using a waterproof marker on firmly affixed, water-resistant labels:

- HEIS number
- Sample collection date/time
- Name/initials of person collection sample
- Analysis required
- Preservation method if applicable.

### E.2.5.2 Chain of Custody

A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples (cooler) shipped to any laboratory in accordance with EIP 3.0, "Chain of Custody" (BHI 1995). The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Chain-of-custody procedures will be followed throughout the sample collection, transfer, analysis, and disposal to ensure that the integrity of samples is maintained. Each time responsibility for custody of the samples changes, the new and previous custodians will sign the record and denote the date and time. A copy of the signed record will be made by the sampler any time samples are delivered to a laboratory.

A custody seal (evidence tape) shall be affixed to the lid of each sample jar. The container seal will be inscribed with the sampler's initials and the date sealed. For any sample jars collected inside the glovebox and "bagged-out," the evidence tape may be affixed to the seal of the bag to demonstrate no tampering has occurred. This will eliminate problems associated with contaminated soils adhering to the custody tape while inside the glovebox.

### E.2.5.3 Field Sampling Log

All information pertinent to field sampling and analysis will be recorded in bound logbooks in accordance with EIP 1.5, "Field Logbooks" (BHI 1995). The sampling team will be responsible for recording all relevant sampling information, including but not limited to the information listed in Appendix A of EIP 1.5. Entries made in the logbook will be dated and signed by the individual who made the entry.

## E.3 SAMPLE COLLECTION

### E.3.1 SOIL SCREENING

The field screening measurement of radioactivity associated with soils removed from the 1301-N and 1325-N characterization boreholes will assist in selection of supplementary sample intervals. All samples and cuttings from the boreholes will be field screened by the field geologist or radiological control technician (RCT). They will use portable scintillation counters for radionuclide screening. The field screening instruments will be used, maintained, and calibrated consistent with the manufacturer's specifications and other approved procedures. The field geologist will record field screening results in the borehole log.

Site background for field screening purposes will be established at each borehole after setting up a portable shielding enclosure. Site background levels of radiation inside the portable shielding will be measured using the scintillation counters before drilling begins and on a daily basis, at minimum. The field geologist will record the site background levels in the borehole log per EIP 7.0, "Geologic Logging" (BHI 1995), prior to the start of drilling.

Drill cuttings will be collected, placed in the portable shielding enclosure, and field screened by measuring the radioactivity using the portable scintillation counters. The measured radioactivity will be compared to the site (shielded) background to assist in selecting split-spoon sample collection intervals and to determine when additional grab samples should be collected from the borehole. If the field screening instrumentation reads three times the activity of the previous interval of drive barrel cuttings, a grab sample will be collected from the cuttings.

## E.3.2 SOIL SAMPLING

### E.3.2.1 General Sampling Requirements and Methods

Chemical/radionuclide, physical properties, and archive samples will be collected from each borehole as specified below. The sampling will be performed in accordance with EIP 4.0, "Soil and Sediment Sampling" (BHI 1995), using a split-spoon sampler or the drive barrel and analyzed for the parameters listed in Table E-1. If insufficient soil is retrieved in the split spoon to satisfy the volumetric requirements for sample analysis, the split spoon will be re-driven or additional sample retrieved from the drive barrel. The chemical/radiological portion of the sample will take precedence over physical properties samples, which take precedence over archival samples. The drive barrel can be used to obtain physical properties samples when insufficient samples are obtained with the split spoon, although use of the split-spoon sampler is required to collect physical properties samples for bulk density/porosity, moisture content, and permeability measurements. Archive samples may be collected from the split-spoon sampler or the drive barrel. An entry will be made in the borehole log identifying the sample collection method and depth intervals using the codes presented in Table E-2.

Table E-2. Sample Type Designation Codes.

| Sample Type | Sample Type Designation | Purpose of Sample |
|---|---|---|
| Chemical | CH | Provide material for chemical and radiological analysis to determine contaminant inventory and extent of contamination in cribs and vadose zone. |
| Physical | PH | Provide material for determination of physical characteristics of soil and sediment. |
| Archive | AR | Provide materials for future chemical analysis or physical properties testing. Provides a representative physical record of the lithologies encountered during drilling activities. |

### E.3.2.2 Analytical Soil Sampling

Each borehole will be sampled at four specific intervals using the split-spoon sampler as shown in Figure E-2. The split-spoon samplers will be equipped with four separate stainless steel liners for chemical/radiological samples. Lexan liners or stainless steel liners may be used to collect physical properties samples. Split-spoon samplers and stainless steel liners will be decontaminated in accordance with EII 5.5, "Laboratory Cleaning of RCRA/CERCLA Sampling Equipment" (WHC 1988). Before the head and shoe are removed from the split-spoon sampler, drilling personnel are required to mark the sampler (with chalk or other suitable technique) to ensure that the sampling personnel or geologist can distinguish the top and bottom of the sampler. All split-spoon sampling depths will be referenced to the maximum depth the split spoon is driven. All depths will be recorded to the nearest 0.10 of a foot. Liners within the sampler will be designated alphabetically A, B, C, and D. Liner "A" will be located next to the shoe of the sampler, while liner "D" is located near the head of the sampler (Figure E-2).

Figure E-2. Cross Section Depicting Split-Spoon Liner Designation.


In addition, grab samples will be obtained from the drive barrel drill cuttings at 3-m (10-ft) intervals to final depth. Field screening will be used to monitor drill cuttings obtained with the drive barrel and to identify alternate grab sampling points not presented in this DOW. For example, if a contaminated zone occurs before a designated sampling point, a grab sample will be obtained if the field screening criteria are exceeded. Grab samples will involve emptying the contents of the drive barrel into separate heavy-mil plastic bagging, and then the sampler will use a stainless steel spoon to collect soil from the bag and containerize in sample jars.

The initial split-spoon sample interval for borehole B2536 will be located to intersect the 1301-N crib base/vadose zone soil interface (Figure E-1). This depth is currently projected to be 3.7 m (12 ft) bgs, although drill pad construction will likely change this sample depth. The initial split-spoon sample interval in borehole B2537 will be located to intersect the 1301-N trench base/vadose zone soil interface, as projected from the base of the trench. This depth is currently projected to be 3.7 m (12 ft) bgs, although drill pad construction will likely change this sample depth due to grading at the surface. The initial sample from borehole B2539 will be collected at approximately 2.1 m (7 ft) bgs at the approximate base of the 1325-N crib structure. As with the other characterization boreholes, drill pad construction may modify this initial sample depth. A final determination of the initial sample depths will be made prior to the start of drilling. The site geologist will need to use professional judgment and field screening data to determine the appropriate intervals for obtaining samples at depths greater than 3.7 m (12 ft) bgs.

The field screening criteria established in Section E.3.1 will be used to ensure that the most contaminated material from each sampling interval is submitted for analysis. This will involve screening the ends of the split spoon after the drive head and shoe are removed. The split spoon will be opened and the liners surveyed. If an interval is identified that is more contaminated than surrounding material, it will be separated from adjacent liners and a sample will be obtained. If insufficient material is present to satisfy all the bottle requirements for analysis, a composite sample will be obtained by mixing material from above and below the contaminated interval. A Radiation Work Permit (RWP) will specify radiological criteria for when the split spoon can be opened outdoors in a Radiological Control Area or when it must be opened inside a glovebox. If the radiological contamination exceeds the RWP, the split spoon will be lowered back inside the well casing until health and safety documentation can be reviewed and revised.

All split-spoon samples shall have a representative portion submitted to the 222-S Laboratory or to the Environmental Analytical Laboratory (EAL) at 100-N for total activity analysis. This will be utilized for sample pre-shipment characterization. Chemical and radiological samples with a total activity of less than the established laboratory criteria will be analyzed at an offsite laboratory. Those samples exceeding the laboratory criteria will be repackaged to meet laboratory dose rate criteria or routed to a designated onsite laboratory for analysis. Onsite and offsite laboratories will be identified prior to initiating field activities and will be mutually acceptable to Environmental Restoration Contractor (ERC) Sample Management and the cognizant engineer. All grab samples will be analyzed for the radiological constituents of concern by the 222-S Laboratory or the EAL.

Samples collected for physical analysis and unconditionally released by the RCT as nonradioactive will be submitted to the Geotechnical Engineering Cold Laboratory. Radioactive physical samples that do not exceed 25 mrem will be submitted to the Geotechnical Engineering Hot Laboratory. Samples exceeding 25 mrem will be stored at a temporary radioactive storage area until a determination is made if they will be analyzed. Physical samples not tested will be stored onsite in containers until dealt with in accordance with the project waste control plan. All sample containers will be labeled with applicable borehole number, sampling date, time, depth interval to the nearest foot (physical samples only), HEIS number, requested analysis, and the sampler's initials.

Splits of sample intervals may be obtained for Ecology from each borehole identified before the start of drilling. Ecology will be present and work in conjunction with the field team leader and the samplers to obtain sample splits. Ecology will assume responsibility that the samples are properly collected. Shipping requirements will be determined based on the total activities. Ecology will ship any of their samples that are not radioactive. The ERC will assist Ecology on a case-by-case basis in the shipment of radioactive samples using the Westinghouse Hanford Company (WHC) Transportation Services. Prior to providing Ecology samples that are radioactive, laboratory documentation specifying U.S. Nuclear Regulatory Commission licenses must be provided to the ERC for the Ecology laboratory.

**E.3.2.2.1 Chemical and Radionuclide Analysis.** Soil samples for characterizing chemical and radionuclide contaminants will be collected from each borehole at the intervals presented in Figure E-1. Chain-of-custody documentation will be prepared by the sampling scientist. Container and volume requirements for chemical and radiological samples are presented in Table E-1. The laboratory will use existing Level III methods for chemical analysis and Level V methods approved under their contract for radionuclide analyses. Samples collected with the split-spoon sampler will be analyzed for all constituents as specified in Table E-1. Grab samples will be analyzed only for radiological constituents as specified in Table E-1.

If full sample volume requirements cannot be met, the volume obtained will be recorded in the sampling scientist's logbook per EIP 1.5, "Field Logbooks" (BHI 1995) and analyzed in the following order:

1. Radionuclides
2. Metals

**E.3.2.2.2 Physical Property Analysis.** Samples for determining the physical parameters of the vadose zone will be collected only at boreholes B2537 and B2539 at the intervals presented in Figure E-1 for Table E-1 analysis. Sample volume and container recommendations for physical properties analyses are presented in Table E-1. Four sample intervals will be collected with the split-spoon sampler, coincident with the four chemical split-spoon sampling intervals discussed in Section E.3.3.2.1. These sampling intervals will be tested for bulk density, porosity, permeability, moisture content, and moisture retention. These tests require at least one full and relatively undisturbed split-spoon liner and one filled 400-g moisture tin. Grab samples will be collected at 3-m (10-ft) intervals from the drive barrel, coincident with the radiological grab sample intervals. These samples will be tested for grain-size distribution and moisture content. Material larger than 7.62 cm (3 in.) will be removed from cuttings collected with the drive barrel before placing in the sample container.

Samples submitted to the WHC Geotechnical Engineering Laboratory (GEL) for analysis will be marked with the WHC GEL method number corresponding to the analysis requested on the sampling and analysis request form, e.g., GEL-07. The physical property samples will be analyzed using American Society for Testing and Materials (ASTM) methods to determine the following parameters:

- Particle size distribution per ASTM D422 (GEL-07)
- Bulk density/porosity per ASTM D2937 and ASTM D4564 (GEL-14)
- Permeability per ASTM D2434 (GEL-09)
- Moisture retention per ASTM D2325 and ASTM D3152 (GEL-18)
- Moisture content per ASTM D2216 (GEL-14).

### E.3.2.3 Archive Sampling

All material removed from a borehole will be identified and described by the site geologist and summarized on the borehole log. Samples for archive will be collected and described every 3 m (10 ft) and at significant changes of lithology as determined by the field geologist. Archive samples will be stored onsite for up to one year in a sheltered radiologically controlled storage area.

Each archive sample will be labeled with the appropriate sample depth interval (to the nearest foot), date, and time the sample was obtained. Chain-of-custody documentation as detailed in EIP 3.0, "Chain of Custody" (BHI 1995), will be prepared by the site geologist. Each archive interval will be logged in the field logbook and the borehole log. Samples will be archived in sealed 1-L wide-mouth jars or double-contained plastic bags.

### E.3.4 GEOPHYSICAL LOGGING

High-resolution spectral gamma-ray and neutron moisture logs will be collected from all characterization boreholes and existing monitoring wells 199-N-35, 199-N-45, and 199-N-67. The characterization boreholes will be logged with spectral gamma-ray and neutron moisture sondes prior to telescoping of casing during drilling. In addition, a final spectral gamma-ray log will be collected over the entire length of each characterization borehole prior to abandonment. Existing wells will be logged over their entire length to groundwater using both spectral gamma-ray and neutron moisture sondes. The site geologist will record all geophysical logging runs performed at the characterization boreholes including the depth interval of initial and repeat runs. All geophysical logging will be performed in accordance with EII 11.1, "Geophysical Logging" (WHC 1988).

Spectral gamma-ray logs will be used to determine and confirm the vertical distribution and concentration of all gamma-emitting radionuclides of concern down to the low pCi/g range. In addition, the spectral gamma-ray logging will ascertain the vertical distribution and concentration of other radionuclides such as $^{238}Pu$, $^{239/240}Pu$, and uranium in the nCi/g to $\mu$Ci/g range. Neutron moisture logs will be used to determine and confirm the vertical distribution of moisture in the soil column at the LWDFs.

## E.4 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

Special care should be taken to prevent cross-contamination of sampling equipment, sampling bottles, or anything else that could potentially compromise the integrity of the samples. Particular care will be exercised to avoid the following common ways in which cross contamination or background contamination may compromise soil samples:

- Improper storage or transportation of sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting them on or near potential contamination sources such as uncovered ground
- Handling bottles or equipment with dirty hands.

Internal quality control samples shall be collected as specified in the Quality Assurance Project Plan (QAPjP) located in Appendix F. The sampling shall be documented in the sampling logbook per EIP 1.5, "Field Logbooks" (BHI 1995).

1. Collect one duplicate per borehole or every 20 samples, whichever is greater from the split-spoon sampler and analyze per Table E-1.
2. Collect split samples at the same frequency as duplicates if a split laboratory is designated and analyze per Table E-1.
3. Field blanks are not required.

4. Collect equipment blanks at the same frequency as duplicates and analyze for constituents listed in Table E-1. The media shall be silica sand.

Quality assurance/quality control for geophysical logging is specified in the QAPjP found in Appendix F.

## E.5 SAMPLE PACKAGING AND SHIPMENT

The outside of each sample jar will be surveyed by the RCT to be free of smearable surface contamination. In addition, the RCT will measure the radiological activity on the outside of the sample container (through the container) and will mark the container with the highest contact radiological reading in either disintegrations per minute or mrem/h as applicable. Any sample jars exhibiting radiological activity will be labeled with the word "Radioactive" in accordance with U.S. Department of Transportation requirements. All samples will have total activity analysis done by the 222-S Laboratory or EAL prior to shipment to select proper packaging, marking, labeling, and shipping paperwork and to verify that the sample can be received by the offsite analytical laboratory in accordance with the laboratory acceptance criteria. Special arrangements have been made for the offsite laboratory to receive samples less than 100 mR/h, and any samples greater than 10 mR/h require laboratory notification prior to shipment. Samples with radiological reading greater than 100 mR/h will not be shipped offsite, but will be analyzed by an onsite laboratory.

## E.6 REFERENCES

ASTM, 1993, *1993 Annual Book of ASTM Standards*, Volume 04.08, American Society for Testing and Materials, Philadelphia, Pennsylvania.

BHI, 1995, *Environmental Investigation Procedures*, BHI-EE-01, Vol. 1 and 2, Bechtel Hanford, Inc., Richland, Washington.

Chieco, N.A., D.C. Bogen, and E.O. Knutson (editors), 1990, *EML Procedures Manual*, HASL-300-ED.27, Volume 2, Environmental Measurements Laboratory, U.S. Department of Energy, New York, New York.

WHC, 1988, *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

# APPENDIX F

# QUALITY ASSURANCE PROJECT PLAN

# APPENDIX F

# QUALITY ASSURANCE PROJECT PLAN

## F.1 PROJECT DESCRIPTION

Three vadose zone boreholes, B2536, B2537, and B2539, will be drilled and sampled to investigate the distribution of radionuclide and metal contamination and moisture content in soil beneath the 1301-N and 1325-N Liquid Waste Disposal Facilities (LWDFs). Locations of the boreholes are shown in Figure 1 of the description of work (DOW). Borehole B2536 will provide data on vertical distribution of contaminants with depth in the highest contaminant zone to verify the conceptual model and data on moisture content with depth to evaluate the presence of a driving force to groundwater. Borehole B2537 will provide information on the lateral spreading of contaminants and moisture content to verify the conceptual model and provide physical samples for modeling purposes to evaluate potential impacts to groundwater. Borehole B2539 will be drilled adjacent to the 1325-N crib to provide similar data and information for the 1325-N LWDF. Spectral gamma-ray and neutron moisture geophysical logs will be collected at the characterization boreholes and at existing monitoring wells near the 1301-N and 1325-N LWDFs to provide information on the distribution of contaminants and concentrations in the old groundwater mound. The existing wells to be logged include 199-N-35, 199-N-45, and 199-N-67. The locations of these wells are illustrated in Figure 1 of the DOW. The existing wells to be logged may change due to access problems, however.

## F.2 PROJECT ORGANIZATION AND RESPONSIBILITY

### F.2.1 TECHNICAL LEAD RESPONSIBILITY

The environmental engineering organization of the Environmental Restoration Contractor Team has primary responsibility for conducting this sampling routine. Organizational charts found in the *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-NR-1 Operable Unit Hanford Site, Richland, Washington* (DOE-RL 1994) identify staff assignments and responsibilities.

The project technical lead is responsible for directing and approving all technical aspects of this sampling routine, for coordinating efforts of internal functional organizations, and to evaluate and select external contractor and subcontractors as needed to complete the required task activities.

### F.2.2 ANALYTICAL LABORATORIES AND FIELD SCREENING ORGANIZATIONS

Analytical Laboratories and Field Screening organizations will be responsible for performing analytical services and field screening activities as outlined in the project Request for Analytical Services, EIP 2.0 (BHI 1995a), the project work order, or contractor procurement document.

Analytical Laboratories and Field Screening organizations will be responsible for performing all services in accordance with the requirements outlined in this Quality Assurance Project Plan (QAPjP).

### F.2.3 OTHER SUPPORT CONTRACTORS

Procurement of all other contracted field activities, material, and equipment shall be in compliance with the standard Bechtel Hanford, Inc. (BHI) procurement procedures and requirements as outlined in BHI-PR-01 (BHI 1995b).

## F.3 QUALITY ASSURANCE FOR MEASUREMENTS

The rationale for establishing data quality objectives and other data needs for this limited field investigation are discussed in Section 1.1 of the DOW. All analytical parameters that have been selected for this investigation are listed in Table F-1, cross-referenced to analytical method requirements and maximum detection limit values for precision and accuracy. The detection limits and associated precision and accuracy ranges are provided that shall be considered maximum values that can be reliably achieved by analytical laboratories under routine conditions. Detection limits and associated precision and accuracy ranges for those constituents measured with geophysical techniques are considered maximum values when borehole or well conditions and configuration are in accordance with the conditions and configuration established for the instrument calibration models. The requirements of Table F-1 shall be considered a minimum performance standard, and shall be incorporated into the agreements for services established with individual Westinghouse Hanford Company, participant contractor, or other subcontractor analytical laboratories and services. Any modification of Table F-1 requirements shall be justified by the requestor, and shall be considered a formal modification of this QAPjP, and is subject to regulatory review and approval.

Goals for data representativeness will be addressed qualitatively by the specification of sampling depths and intervals in the Sampling and Analysis Plan (SAP) (Appendix E). Sampling and geophysical logging locations and intervals will be specified in the SAP (Appendix E) and transmitted to subcontractors and personnel performing the sampling and geophysical logging. Objectives for the completeness of this investigation shall require that contractually or procedurally established requirements for precision and accuracy be met for at least 90% of the total number of requested determinations. Failure to meet this criterion shall be documented and evaluated in the validation process described in Section F.8 of this QAPjP; corrective action shall be taken as warranted, as described in Section F.13. Approved analytical procedures shall require the use of the reporting techniques and units specified in the U.S. Environmental Protection Agency reference methods specified in Table F-1 in order to facilitate the comparability of data sets.

Table F-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements. (3 Sheets)

| | Analytical Category | Analytical Parameters | Analytical Method | Detection Limit | Precision[a] | Accuracy[a] |
|---|---|---|---|---|---|---|
| Split-Spoon Samples | Metals | Cadmium<br>Chromium<br>Lead<br>Nickel | SW-846;<br>Method 6010<br>ICP - Metals | 1.0 ppm | ±20 | 75-125 |
| | Radionuclides | Strontium-90 | Sr-02[b] | 1.0 pCi/g | ±35 | 75-125 |
| | | Alpha Spectrometry<br>Uranium-233/234<br>Uranium-238<br>Plutonium-238<br>Plutonium-239/240 | ASTM D 3084[c] | 0.6 pCi/g<br>(for all parameters) | ±35 | 75-125 |
| | | Gross alpha | Water 901.1<br>Soil[d] | 7.0 pCi/g | ±35 | 75-125 |
| | | Gross beta | Water 901.1<br>Soil[d] | 8.0 pCi/g | ±35 | 75-125 |
| | | Gamma Spectrometry<br>Potassium-40<br>Manganese-54<br>Cobalt-60<br>Ruthenium-106<br>Cesium-134<br>Cesium-137<br>Cerium-134<br>Europium-152<br>Europium-154<br>Radium-226<br>Thorium-228<br>Thorium-232 | Water 901.1<br>Soil[d] | <br>10.0 pCi/g<br>0.25 pCi/g<br>0.05 pCi/g<br>1.5 pCi/g<br>0.25 pCi/g<br>0.25 pCi/g<br>0.75 pCi/g<br>0.60 pCi/g<br>0.75 pCi/g<br>4.5 pCi/g<br>0.6 pCi/g<br>0.6 pCi/g | ±35 | 75-125 |
| | Physical Properties | Moisture Content | ASTM D2216<br>(GEL-14) | N/A | N/A | N/A |
| | | Moisture Retention | ASTM D2325<br>ASTM D3152<br>(GEL-18) | N/A | N/A | N/A |
| | | Bulk Density/Porosity | ASTM D2937<br>ASTM D4564<br>(GEL-14) | N/A | N/A | N/A |
| | | Permeability | ASTM D2434<br>(GEL-09) | N/A | N/A | N/A |
| | | Particle Size Distribution | ASTM D422<br>(GEL-07) | N/A | N/A | N/A |

Table F-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements. (3 Sheets)

| | Analytical Category | Analytical Parameters | Analytical Method | Detection Limit | Precision[a] | Accuracy[a] |
|---|---|---|---|---|---|---|
| Grab Samples | Radionuclides | Strontium-90 | Sr-02[b] | 1.0 pCi/g | ±35 | 75-125 |
| | | Gross Alpha | Gas Proportional | 7.0 pCi/g | ±35 | 75-125 |
| | | Gross Beta | Gas Proportional | 8.0 pCi/g | ±35 | 75-125 |
| | | Gamma Spectrometry<br>Potassium-40<br>Manganese-54<br>Cobalt-60<br>Ruthenium-106<br>Cesium-134<br>Cesium-137<br>Cerium-134<br>Europium-152<br>Europium-154<br>Radium-226<br>Thorium-228<br>Thorium-232 | Gamma Spectrometry | 0.05 pCi/g (for all parameters) | ±35 | 75-125 |
| | Physical Properties | Moisture Content | ASTM D2216 (GEL-14) | N/A | N/A | N/A |
| | | Particle Size Distribution | ASTM D422 (GEL-07) | N/A | N/A | N/A |
| Geophysical Logging | Radionuclides | Gamma Spectrometry<br>Uranium-233<br>Uranium-234<br>Uranium-238<br>Plutonium-238<br>Plutonium-239<br>Plutonium-240 | RLS | <br>150.0 pCi/g<br>300.0 pCi/g<br>25.0 pCi/g<br>1.6 nCi/g<br>20.0 nCi/g<br>85.0 nCi/g | ±35 | ±10% |
| | | Gamma Spectrometry<br>Potassium-40<br>Manganese-54<br>Cobalt-60<br>Ruthenium-106<br>Cesium-134<br>Cesium-137<br>Cerium-134<br>Europium-152<br>Europium-154<br>Radium-226<br>Thorium-228<br>Thorium-232 | RLS | <br>2.0 pCi/g<br>1.0 pCi/g<br>1.0 pCi/g<br>5.0 pCi/g<br>1.0 pCi/g<br>1.0 pCi/g<br>5.0 pCi/g<br>1.0 pCi/g<br>1.0 pCi/g<br>5.0 pCi/g<br>5.0 pCi/g<br>1.0 pCi/g | ±35 | ±10% |
| | Physical Properties | Moisture Content | Neutron Moisture Logging | 2% VFW | 1% of VFW or 10% of measurement | 2% of VFW or 20% of measurement |

Table F-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements. (3 Sheets)

[a]Precision is expressed as Relative Percent Difference (RPD); accuracy is expressed as percent recovery (%R) except where noted. For laboratory analytical samples, these limits apply to sample results greater than five times the required detection limit, and shall be considered requirements in the absence of known or suspected interferences which may hinder achieving the limit by the analytical laboratory. The RPD and %R are assessed relative to matrix and duplicate spikes for analytical parameters analyzed in the laboratory.

[b]Methods specified are from the *EML Procedures Manual* (Chieco et al. 1990)

[c]Method specified is from the *1993 Annual Book of ASTM Standards* (ASTM 1993).

[d]Method shall be based on the specified water method, modified to allow measurement of the parameter of interest in a soil sample, and shall be submitted for Bechtel Hanford, Inc. review and approval prior to use.

ASTM - American Society of Testing and Materials
GEL-## - Westinghouse Hanford Company Geotechnical Engineering Laboratory
N/A - Not Applicable
RLS - Radionuclide Logging System
VFW - Volume Fraction Water

## F.4 SAMPLING PROCEDURES

All sampling shall be performed in accordance with procedures identified in the BHI-EE-01, *Environmental Investigation Procedures* (EIP) (BHI 1995a). Procedures for sampling activities not covered in the BHI-EE-01 manual will be prepared by the project personnel and will be attached to the DOW.

Sample packaging and shipping will be performed in compliance with EIP 3.1 (BHI 1995a). Logbook entries will be performed in compliance with EIP 1.5 (BHI 1995a). Sample chain of custody will be maintained in accordance with EIP 3.0 (BHI 1995a).

Items to be identified in the DOW are:

1. sampling depth
2. sampling intervals
3. sampling location
4. sample preservation
5. sample container specification
6. sample analysis
7. quality assurance/quality control (QA/QC) samples
8. sample hold time
9. project-specific sampling procedures.

## F.5 SAMPLE CUSTODY

### F.5.1 FIELD CUSTODY

All samples obtained during the course of this project will be controlled from the point of origin to the analytical laboratory as required by EIP 3.0, "Chain of Custody" (BHI 1995a).

### F.5.2 LABORATORY CUSTODY PROCEDURES

Laboratory custody procedures will be addressed in BHI-EE-06, *Environmental Analytical Laboratory Quality Assurance Plan* (BHI 1995c). Subcontract Laboratories will address laboratory custody in the laboratory's standard operating procedures. Laboratory custody procedures will ensure the maintenance of sample integrity and identification throughout the analytical process.

### F.5.3 FINAL EVIDENCE CUSTODY PROCEDURES

All relevant records, reports, logs, field notebooks, pictures, subcontract reports, and analytical reports will be secured and stored in accordance with the Document Control section of BHI-MA-01 (BHI 1995d).

## F.6 CALIBRATION PROCEDURES

All sampling, field screening, and analytical equipment used on this project will be calibrated to operate within the manufacturer's specifications. Calibrations will be performed as stipulated by the manufacturer's calibration procedure, the project-specific calibration procedure, or an analytical method.

These procedures are addressed in BHI-EE-06, *Environmental Analytical Laboratory Quality Assurance Plan* (BHI 1995c); BHI-EE-08, *Field Screening Quality Assurance Plan* (BHI 1995e); or in the subcontractor's QA Plan.

## F.7 ANALYTICAL PROCEDURES

The analytical methods and field screening procedures to be used by the Analytical Laboratories and Field Screening organizations will be specified by completing a request for analytical services (form #BHI-EE-003) and in accordance with EIP 2.0, "Sample Event Coordination" (BHI 1995a), the project work order, or contractor procurement documents.

## F.8 DATA REDUCTION VALIDATION AND REPORTING

### F.8.1 REDUCTION

All analytical laboratories shall be responsible for preparing a report summarizing the results of analysis and for preparing a detailed data package. The data package includes identifying samples, sampling and analysis dates, raw analytical data, reduced data, data outliers, reduction formulas, recovery percentages, quality control check data, equipment calibration data, and documentation of any nonconforming condition affecting the measurement system. Data reduction schemes shall be contained within laboratory analytical methods or laboratory procedures. The completed data package shall be reviewed and approved by the analytical laboratories QA manager or team lead for field screening-type activities. Completed data packages will be submitted to the Data Management Group for validation. The requirements of this section will be included in procurement documentation or work orders as appropriate.

### F.8.2 VALIDATION

Validation of completed data packages will be performed by qualified BHI Data Management personnel or by a qualified subcontractor. Subcontract validation requirements will be defined in procurement documentation or work orders as appropriate. At a minimum, 10% of all offsite analytical laboratory data packages received will be validated.

All coordination of validated services, execution of data validation activities, and handling and storage of deliverables will be accomplished in accordance with EIP 2.5, "Data Package Validation Process" (BHI 1995a).

### F.8.3 FINAL REVIEW AND RECORDS MANAGEMENT

All validated reports and supporting analytical data packages shall be subject to final technical review by qualified reviewers before their submittal to regulatory agencies or inclusion in reports or technical memoranda, at the direction of the BHI technical lead. All validated reports and data packages shall be retained as permanent project records in compliance with the Document Control section of BHI-MA-01 (BHI 1995d).

## F.9 INTERNAL QUALITY CONTROL

Several control samples are introduced into the collection system to monitor the adequacy of the sampling system and the integrity of samples during their journey from the field collection point through laboratory analysis. These samples are defined below with their mode of collection and purpose. QA/QC sample frequency and type will be identified in the DOW.

### F.9.1 FIELD QUALITY CONTROL REQUIREMENTS

#### F.9.1.1 Equipment Rinsates

Equipment rinsates are samples of pure silica sand passed through decontaminated sampling equipment prior to use of the equipment. They are used as a measure of decontamination process effectiveness. Equipment rinsates should be collected in the field and at the rate specified in the DOW. An equipment rinsate should be collected from each type of sampling equipment used to ensure that the decontamination procedures are applicable to all equipment types.

Equipment rinsates are analyzed for the same analytes as samples collected using that equipment. All sample results should be evaluated to determine the possible effects of any contamination detected in the equipment rinsate blank.

#### F.9.1.2 Field Duplicates and Splits

Field duplicates are two samples produced from material collected in the same location. Each will be numbered uniquely. Field duplicates provide information regarding the homogeneity of the matrix. A matrix constitutes soil, sediment, water, biota, or waste from a given site. Field duplicate may also provide an evaluation of the precision of the analysis process. Field duplicates for soil are collected and homogenized before being divided into two samples in the field. Field duplicates will normally be collected at a frequency of 5% to 10% of the samples collected per matrix.

Field duplicates should be sent to the laboratory in the same manner as the routine site samples. They may or may not be identified to the laboratory as field splits. It may maximize the utility of information to submit extra samples from the field splits for the laboratory to use as duplicates. This will help distinguish between variability resulting from sample heterogeneity and laboratory manipulation. Field duplicate data should be reviewed for agreement. Data should meet the precision criteria established in the DOW.

### F.9.2 ANALYTICAL LABORATORY QUALITY CONTROL REQUIREMENTS

#### F.9.2.1 Matrix Spike Samples

Matrix spike samples require the addition of a known quantity of a representative analyte of interest to the sample as a measure of recovery percentage. The spike shall be made in a replicate of field sample. Replicate samples are separate aliquots removed from the same sample container in the laboratory. Spike compound selection, quantities, and concentrations shall be described in the analytical procedures. One sample shall be spiked per analytical batch, or once every 20 samples, whichever is greater.

#### F.9.2.2 Matrix Spike Duplicate Samples

Ten percent of all matrix spiked samples shall be duplicates in the laboratory and analyzed separately as an overcheck for accuracy.

#### F.9.2.3 Quality Control Reference Samples

QC reference sample shall be prepared from an independent standard at a concentration other than that used for calibration, but within the calibration range. Reference samples are required as an independent check on analytical technique and methodology, and shall be run with every analytical batch, or every 20 samples, whichever is greater.

## F.10 PERFORMANCE AND SYSTEM AUDITS

BHI QA will conduct random surveillances and assessments to verify compliance with the requirements outlined in this work plan, the project work packages, the BHI *Quality Management Plan* (BHI 1994), and BHI procedures. Collectively the surveillances and assessments will address quality-affecting activities that include, but are not limited to, measurement system accuracy; field activities; and data collection, processing, validation, and management.

## F.11 PREVENTIVE MAINTENANCE

All measurement and testing equipment used in the field and in the laboratory that directly affects the quality of the analytical data shall be subject to preventive maintenance measures that ensure minimization of measurement system downtime. Laboratories and field screening organizations shall be responsible for performing or managing the maintenance of their equipment. Maintenance requirements such as parts lists and instruction shall be included in individual laboratory and field screening organizations QA plan or operating procedures.

## F.12 DATA ASSESSMENT PROCEDURES

Analytical data shall be compiled, reduced, and reviewed by the laboratory and validated in a manner appropriate for the individual analytical method prior to presentation to contractor personnel for validation. Assessment of the validated data will follow the general guidelines established in Section 5.1.1.10 of DOE/RL-90-22, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-NR-1 Operable Unit Hanford Site, Richland, Washington* (DOE-RL 1994). Depending on the distribution and statistical characteristics of the validated data and other area-specific considerations, various statistical and/or probabilistic techniques may be selected for use in the process of data comparison or analysis. The selection of any such methodology shall be subject to the approval and authorization of the BHI technical lead. Methods shall be documented, signed, dated, retained as project records in compliance with BHI-MA-01 (BHI 1995d), and, as appropriate, considered in the risk assessment and field report preparation tasks.

## F.13 CORRECTIVE ACTION

Corrective action required as a result of surveillance reports, nonconformance reports, or audit activities shall be documented and dispositioned as required by BHI-QA-02. Other measurement systems, procedures, or plan corrections that may be required as a result of routine review processes shall be resolved as required by governing procedures or shall be referred to the technical lead for resolution.

## F.14 QUALITY ASSURANCE REPORTS

Project activities shall be regularly assessed by random audits, surveillances, and assessments. All findings from audits, surveillances, and assessments will be transmitted to the project manager and the BHI QA department for program-related tracking and trending. Otherwise, the routine evaluation of data quality described throughout this QAPjP will be documented and filed along with the data in the project file. The final report will include an evaluation of the overall adequacy of the total measurement system with regard to the data quality objective of the data generated.

## F.15 REFERENCES

ASTM, 1993, *1993 Annual Book of ASTM Standards*, Volume 04.08, American Society for Testing and Materials, Philadelphia, Pennsylvania.

BHI, 1994, *Quality Program Procedures*, BHI-QA-02, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1995a, *Environmental Investigation Procedures*, BHI-EE-01, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1995b, *Procurement Procedures Manual*, BHI-PR-01, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1995c, *Environmental Analytical Laboratory Quality Assurance Plan*, BHI-EE-06, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1995d, *Bechtel Management Policies*, BHI-MA-01, Bechtel Hanford, Inc., Richland, Washington.

BHI, 1995e, *Field Screening and Quality Assurance Plan*, BHI-EE-08, Bechtel Hanford, Inc., Richland, Washington.

Chieco, N.A., D.C. Bogen, and E.O. Knutson (editors), 1990, *EML Procedures Manual*, HASL-300-ED.27, Volume 2, Environmental Measurements Laboratory, U.S. Department of Energy, New York, New York.

DOE-RL, 1994, *RCRA Facility Investigation/Corrective Measures Study Work Plan for the 100-NR-1 Operable Unit, Hanford Site, Richland, Washington*, DOE/RL-90-22, Draft F, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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